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## *THE DEVELOPMENT OF ELECTRICAL SCIENCE.* *

### I.

IN a brief discourse on the development of electrical science little time can be given to the early history of the subject. This part is more or less familiar to all the members of the Academy, and hence it may be passed over by only such brief reference as may serve to recall to mind the more important of the early discoveries. The early Greeks have recorded some elementary phenomena now known to be electric, and it is probable that such knowledge was not uncommon, though little noticed. It is only in comparatively recent times that scientific research has taken the place of superstition and attempts have been made to classify and find reasons for the existence of all natural phenomena.

Beginning with the 17th century, probably the first investigator worthy of notice in this subject was Gilbert, of Colchester, who published his work entitled 'De Magnete' in 1600. Gilbert made systematic experiments and showed that the property of attracting light bodies could be given to a large number of substances by friction. He also showed that the success of the experiment depended largely upon the dryness of the body. These experiments gave rise

* Address of the President delivered before the annual meeting of the Indiana Academy of Sciences on December 29, 1897.

to the classification of substances as electrics and non-electrics. The true significance of Gilbert's observations as to the effect of moisture was not appreciated for a long time. Gilbert's list of electrics was added to by a number of other observers, prominent among whom were Boyle and Newton. The fact that light and sound accompany electric excitation was called attention to by Otto von Guericke, who also showed that a light body after being brought into contact with an electrified body was repelled by it.

Coming now to the 18th century, we find Hawkesbee in 1707 and Wall in 1708 speculating on the similarity of the electric spark and lightning. Then comes one of the most prominent experimenters of this century—Stephen Gray—who began to publish in 1720 and who in 1729 found that certain substances would not convey the charge of an electrified body to a distance. These experiments were the first to introduce the distinction between conductors and non-conductors, and, of course, very soon served to explain the reason why certain substances could not be electrified by friction when held in the hand. Gray also made the important discovery that the charge of an electrified body is proportional to its surface, and this was afterwards confirmed by the experiments of Le Monnier. Many of Gray's experiments were repeated and extended by Du Fay, who found that all bodies could be electrified by friction if they were held by an insulatory substance. Then came the improvements of the electric machine by Boze and Winckler; the firing of inflammatory substances, such as alcohol, by means of the electric spark by Ludolph, Gordon, Miles, Franklin and others. About this time (1745) the properties of the Leyden jar were discovered by Kleist, Cuneus and Muschenbroeck, and a few years later it was given practically its present form by Sir William Watson. Then follows one of the periods of exceptional activity in electrical research. A party of the Royal Society, with Watson as chief operator, made a series of experiments having for their object the determination of the distance to which electrical excitation could be conveyed and the time it takes in transit. They found among other things that several persons at a distance apart might feel the electric shock if they formed part of a circuit between the electrified body and a conductor such as the earth; also that the earth could be used to complete the circuit in Leyden jar discharges. They concluded that when two observers connected by a conductor, and at, say, two miles apart, obtained a shock by one touching the inside coating of a Leyden jar and the other the earth the electric circuit was four miles long, that is, the earth acted as a return conductor. They also concluded that the transmission was practically instantaneous. Watson had ideas as to electric fluids similar to those which were afterwards systematically worked out by Franklin. A great many curious and interesting experiments were made about this time, as, for example, the influence of electrification on the flow of water through capillary tubes as discovered by Boyle, the experiments of Mowbray on the effect of electrification on vegetation, and those of the Abbe Menon on the loss of weight of animals when they were kept electrified for a considerable time.

The effect of electrification on the flow of water has received considerable attention from eminent authorities in recent years, and that of the effect of electrification on the growth and composition of vegetable is at present attracting attention in the form of systematic investigation.

The contributions of Franklin are by far the most important which mark the middle portion of the 18th century. Franklin's experiments were begun about the middle of the year 1747, and seem to have been in-

spired by the receipt of a Leyden jar from a friend, Wm. Collinson, of London. He propounded the theory of positive and negative fluids, which has lately, in a modified form, been brought so prominently into notice again by the writings of Lodge, and he made an investigation of the principle of the Leyden jar, but the most important of his researches relate to the identification of electricity and lightning. The probable identity of the two phenomena had been hinted at, as we have seen, by several observers, but Franklin went systematically to work to test the hypothesis. Under date of November 7, 1749, the following passage is found in his note-book: "Electric fluid agrees with lightning in these particulars: (1) Giving light. (2) Color of the light. (3) Crooked direction. (4) Swift motion. (5) Being conducted by metals. (6) Crack or noise in exploding. (7) Subsisting in water or ice. (8) Rending bodies in passing through. (9) Destroying animals. (10) Melting metals. (11) Firing inflammable substances. (12) Sulphureous smell. The electric fluid is attracted by points; we do not know whether this property is in lightning. But since they agree in all the particulars wherein we can already compare them, is it not probable that they agree likewise in this? Let the experiment be made." The hypothesis was elaborated and sent to his friend Collinson, who communicated it to the Royal Society. This Society rather ridiculed Franklin's ideas at first, but his paper was published in London and also in France, and attracted considerable attention.

The experiment was first made in France by M. d' Alibard, at Marli, on May 10, 1752, and it was repeated shortly afterwards by M. de Lor, in Paris. The results of what were called the Philadelphia experiments were communicated to the Royal Society and caused quite a stir in scientific circles. It is right to say, with regard to the Royal Society, that Franklin's claims to scientific recognition were championed by Sir William Watson, and were fully endorsed by the Society by his election to a Fellowship and the award of the Copley Medal, together with the free donation of the Society's Transactions during his life.

Franklin's own experiments with kites are well known, as is also the method of protecting buildings from lightning which was introduced by him and is still very widely used, although it has been greatly abused by the lightning-rod man.

During the next decade Canton discovered the now commonly known difference between vitreous and resinous electricity. Beccaria experimented on the conducting power of water. Symmer made a number of interesting experiments on the electrification of different kinds of fabrics by friction, and propounded a theory of two electric fluids. Contemporaneous with these were a number of other experimenters who added to the stock of knowledge of this class of phenomena.

The experiments of Aepinus and others on the pyroelectric properties of tourmaline now began to attract attention. The experiments of the Abbé Haüy are perhaps the most important in this connection at this stage of the subject. He found the polar properties of the crystal and showed that similar properties were possessed by a number of other crystals. Aepinus made experiments in other branches of electricity, but he is chiefly noted for his ingenious single-fluid theory of electricity.

Between the years 1770 and 1780 the electrical organs of the torpedo were one of the principal topics of discussion. The experiments of Walsh and Ingenhousz were the first to definitely settle the character of the peculiar power of the fish.

The experiments of Cavendish belong to this period and were remarkable as being quantitative in their character. Consider-

ing the means at his command, the measurements made by this experimenter of the relative conducting powers of various substances must always excite admiration. Cavendish also proved the composition of water by causing different proportions of oxygen and hydrogen to unite by means of the electric spark.

We now come to the classical experiments of Coulomb, who established the law of the variation of the electric force with distance to be that of the inverse square, a law which had previously been inferred from experiments on spheres by Dr. Robinson, who, however, did not publish his results. Coulomb made an elaborate series of experiments on the distribution of electricity over charged conductors as influenced by shape and the proximity of other charged bodies. His theoretical and experimental work formed the basis of the mathematical theory as developed shortly afterwards by Laplace, Biot and Poisson, the work of the latter being particularly important.

Toward the end of the 18th century were made the important researches of Laplace, Lavoisier and Volta, and of Sausure in the electricity produced by evaporation and combustion. This is a subject destined to figure prominently again in the future, and in its rise there is in all probability involved the rapid decline in the importance of the steam engine. I should not be surprised if many of those present should live to see the steam engine practically a thing of the past.

In the 18th century also we must assign the discovery of Galvanic electricity, as the famous frog experiments were made in 1790. Practically no development was made, however, until Volta's work attracted the attention of the scientific world.

At the beginning of the 19th Century, then, we find the subjects of greatest interest were the discoveries of Volta and the invention of the voltaic pile. There followed almost immediately the discovery by Nicholson and Carlisle of the decomposition of water by the voltaic current. This discovery was followed a few years later by those of Sir Humphry Davy on the decomposition of the alkalies and the separation of metallic sodium and potassium. Thus the subject of electrolysis was fairly launched, and what it has grown to be we will see later.

Can there be some inter-relation between electricity and magnetism was now the query? The first positive answer seems to have been given by Romagnesi in a work published in 1805, but little or no notice appears to have been taken of this. Certainly no progress was made in the subject till 1820, when Oersted made his famous experiment before his class. By that experiment he proved that a wire carrying an electric current will, when properly placed, deflect a magnetic needle. The subject was almost immediately taken up by Ampere, and in a few months many of the important consequences which Oersted's discovery involved were developed. Ampere's work on the action of currents on currents and on magnets is classical and is still treated as part of the fundamental basis for the theory of electrodynamics. An account of his work may, therefore, be found in almost any of the numerous text-books on electricity. The conclusions reached by Ampere were confirmed by Weber by a series of much more refined experiments. To Weber also we owe improvements in galvanometers. The same year marks the discoveries by Arago that a current can not only deflect a magnet, but that it is capable of producing one by magnetizing steel needles.

The further discovery was made four years later by Sturgeon that soft iron although incapable of making a strong permanent magnet is yet much more susceptible to temporary magnetization by the electric current. Arago also made about

this time the important discovery that if a needle be suspended above a copper disc and the disc rotated the needle will be dragged round with the disc. This was not explained for some years, but seems to be the first discovery of induced currents.

These experiments mark the discovery of electro-magnetism, and began one of the most important eras in electrical discovery, the work which has been participated in by many eminent authorities. Among the many advances may be mentioned the experiments of Henry on the relative effects of different windings on the strength of an electro-magnet. He deduced the fact that the magnetizing action might be increased either by increasing the number of windings, the current remaining the same, or by increasing the current, the winding remaining the same. He pointed out the application of this to intensity and quantity arrangements of the battery, and also the importance of the intensity winding for the transmission of magnetizing power to a distance, as in telegraphy. The increased effect due to increasing the number of windings on the coil of a galvanoscope had been previously pointed out by Schweigger, and the discovery is embodied in Schweigger's galvanoscope.

In 1821 Faraday began his researches and many important discoveries were made by him. The main guiding idea in Faraday's work was the possibility of obtaining electricity from magnetism and in general the discovery of the inter-relation between the two. In this connection Arago's discovery of the rotation of a copper disc by the rotation of a magnet above it is of great importance, because, among other things, Faraday set himself to explain this. The result was the discovery of the commutatorless dynamo, or Faraday disc. In view of modern developments, probably the most important of Faraday's discoveries was that of the production of a current in a circuit when a current is either established or varied in strength in an adjacent circuit. This was followed by the discovery that relative motion of two circuits, one of which carried a current produced a current in the other, and that the motion of a magnet in the neighborhood of a circuit produced a current in the circuit. Another important discovery by Faraday was that of the quantitative laws which govern electrolytic decomposition, thus giving us our electrochemical equivalents.

At this time Lenz was led by experiment to the discovery of his celebrated law of induction, namely, that the current produced always in turn produces forces tending to oppose the change. For example, if a current be induced in a coil by bringing a magnet towards it the mutual action between the magnet and the current is to oppose the magnet's approach. This is important when looked at from the point of view of the conservation of energy or as an argument against perpetual motion. Lenz's law is, of course, when the actions are properly understood, a consequence of Newton's third law of motion.

Discoveries similar to those of Faraday as to induced currents were made almost simultaneously by Henry in this country. We have in the discoveries of Faraday and Henry the fundamental information required for nearly the whole of our recent developments in dynamo-electric generators and electric motors, but it was reserved for the next generation to develop them. This development we owe in no small degree to the spendid exposition of Faraday's discoveries and their consequences contained in Maxwell's book on electricity and magnetism.

Going back for a moment to 1822 we have to notice another important discovery, namely, the thermoelectric couple by Seebeck. There followed almost immediately the important experiment of Cumming, who

showed that the thermoelectric order of the metals is not the same at all temperatures.

The next important discovery in thermoelectricity was that of Peltier, of the heat generated at the junction of two metals when a current is forced across it against the e. m. f. of the junction. In later years we have the classic researches of Thomson (Kelvin), who added thermoelectric convection and the specific heat of electricity and gave the thermoelectric diagram method of representing results. This method was afterwards used and extended by Tait, who added a good deal to our knowledge of thermoelectric data. Among the large number of others who have worked in this field we may mention Becquerel, Magnus, Matthieson, Leroux and Avenarius. Thermoelectric batteries of considerable power have been made by Clamond and others.

In 1827 the celebrated law giving the relation between e. m. f. resistance and current was published by Ohm in a paper on the mathematical theory of the galvanic circuit. The theory has been sometimes criticised, but there seems to be absolute certainty that the law is almost exact, and it has proved of the greatest importance in the further development of the subject of electric measurements.

The subject had about the middle of the century reached a stage in which it was possible to develop almost completely the mathematical theory as we now have it. Most of the work since Faraday's time has been directed towards quantitative measurements and the furnishing of exact data to answer questions as to how much in various cases. F. E. Neumann discovered what he called the potential function (now called the coefficient of self and mutual induction) of one current on another and on itself and succeeded in giving a theory of induction which was in accordance with the experimental laws. The laws were afterwards experimentally verified by Weber. In 1849 the experiments of Kirchoff on the absolute value of the current induced in one circuit by another, and in the same year Edlund's experiments on self and mutual induction, are important. In 1851 Helmholtz gave a mathematical theory of this part of the subject, which he supplemented with an experimental verification.

One of the most important of the series of experiments made by Henry was on the oscillatory character of the discharge from a Leyden jar. This he discovered from the effect of the discharge on a steel needle surrounded by a coil, through which the current was made to pass. The results of these experiments were communicated to the A. A. A. S. in 1850, but he knew of the effect much earlier, certainly in 1841. Previously the anomalous behavior of the discharge of a jar when used to magnetize steel needles had been noticed, but was attributed, as I believe, to some peculiarity of the steel. Henry was the first to appreciate the true reason, although he could hardly at that time be expected to see the great importance of his discovery.

Helmholtz, in 1847, suggests that the discharge of Leyden jars may be of the nature of a backward and forward movement. There is a curious parallelism in the work of several investigators about this time, and particularly in that of Hemholtz and Thomson. In the *Philosohphical Magazine* for 1855 there is paper by Professor W. Thomson (Kelvin) in which the theory of the discharge of a Leyden jar is discussed and the prediction made that under certain specified conditions the discharge must be oscillatory. A number of similar papers, going back to 1848, treat of similar subjects. Henry's results do not appear to have become generally known, and we find the verification of Thomson's prediction in 1857 by Feddersen. A number of other physicists have investigated the subject, the work of Schiller being of particular

value. The recent applications will be referred to later.

The mathematical theory of electrostatics and magnetism was greatly extended about this time by Thomson and others, and received its most complete statement at the hands of Maxwell in his papers read before the Royal Society and in his book, published in 1873, but still the standard of reference. Very little has since been discovered which was not foreshadowed by Maxwell's theory or contained in his equations, which have been found general enough to cover almost everything, although experiment has generally been necessary to suggest the consequences of the theory.

The practical applications of electricity have played a most important part in the development of the subject during the last sixty years. Indeed, a great part of the work of these years has had some practical application in view. One of the first of these practical applications was that of telegraphy.

The telegraph, being one of the earliest of the practical developments, naturally had a great effect in stimulating the advance in knowledge of electricity, and hence I give a somewhat fuller sketch of the early history, that space will permit for the later applications.

The discovery of Stephen Gray, in 1829, that the electrical influence could be conveyed to a distance by means of an insulated wire, is probably the first of direct influence in connection with telegraphy. As a result of this discovery and the investigations which followed it, a considerable number of proposals were made as to the use of the electrical force for the transmission of intelligence. The first of these of which I have found any record was made in 1753 by Charles Morrison, a Scotchman, and then followed other proposals for electrostatic telegraphs by Bozolus in 1767, by Le Sage in 1774, by Lomond in 1787, by Betancourt in the same year, by Reizen in 1794, by Cavalla in 1795 and by Ronalds in 1816.

The discovery of voltaic electricity, and most directly the discovery of Nicholson and Carlisle of electrolysis gave rise to another group of proposals for the application of this discovery to the production of telegraphy. Among those may be mentioned that of Sömmering in 1809, of Coxe in 1810 and of Sharpe in 1813. In more recent years, of course, the same application appears in the chemical telegraphs, some of which are capable of giving very satisfactory results and great speed.

The discovery which had the greatest influence on the development of telegraphy was that of Oersted, supplemented by the work of Schweigger and Ampere. Ampere proposed a multiple-wire telegraph with galvanoscope indicators in 1820, and a modification was constructed by Ritchie. A single-circuit telegraph of this character was invented by Tribaoillet, but didn't come into use. In 1832 Schilling's five-needle telegraph appeared, and he, also, used a single-needle instrument, but his early death stopped further progress. In 1833 Schilling's telegraph was developed, to some extent, by Gauss and Weber, who used it for experimental purposes. The following quotation, referring to Gauss and Weber's telegraph, from *Poggendorf's Annalen*, is of considerable historical interest:

"There is, in connection with these arrangements, a great and until now in its way novel project, for which we are indebted to Professor Weber. This gentlemen erected, during the past year, a double-wire line over the houses of the town (Göttingen), from the Physical Cabinet to the Observatory, and lately a continuation from the latter building to the Magnetic Observatory. Thus, an immense galvanic chain is formed, in which the galvanic current, the two multipliers at the ends being included, has to travel a distance of nearly

9,000 (Prussian) feet. The line wire is mostly of copper, of that known as 'No. 3,' of which one metre weighs eight grammes. The wire of the multipliers in the Magnetic Observatory is of copper, 'No. 14,' silvered, and of which one metre weighs 2.6 grammes. This arrangement promises to offer opportunities for a number of interesting experiments. We regard, not without admiration, how a single pair of plates, brought into contact at the farther end, instantaneously communicate a movement to the magnetic bar, which is deflected at once for over a thousand divisions of the scale." Further on in the same paper: "The ease with which the manipulator has the magnetic needle in his command, by means of the communicator, had a year ago suggested experiments of an application to telegraphic signalling, which, with whole words and even short sentences, completely succeeded. There is no doubt that it would be possible to arrange an uninterrupted telegraph communication in the same way between two places at a considerable number of miles distance from each other."

The method of producing the currents in Gauss' and Weber's experiments was an application of the important discoveries of Faraday and Henry, above referred to, in the induction of current by currents and by magnets.

On the recommendation of Gauss, this telegraph was taken up by Steinheil, who, following their example, also used induced currents. The important contributions of Steinheil were the discovery of the earth return circuit, the invention of a telegraphic alphabet and a recording telegraph. Steinheil contributes an account of his telegraph to Sturgeon's Annals of Electricity in which the relative merits of scopic, recording and acoustic telegraph are discussed, and the advantages, which experience has since brought into prominence, of the acoustic form are pointed out.

Schiller's telegraph was exhibited at a meeting of German naturalists held at Bonn in 1835, and was there seen by Professor Muncke, of Heidelberg, who, after his return to Heidelberg, made models of the telegraph and exhibited them in his classroom. These models were seen by Cooke in the early part of 1836, and gave him the idea of introducing the electric telegraph in England. Cooke afterward became associated with Wheatstone, and a large number of ingenious arrangements for telegraphing was the result. Many of the later developments by Wheatstone are still in use and are hard to beat.

Steinheil appears to have been anticipated in the idea of making the telegraph self-recording by Morse, who, according to evidence brought forward by himself, thought out some arrangements as early as 1832. Exactly what Morse's first ideas were seems somewhat doubtful, and he did nothing till 1835, when he made a rough model of an electro-magnetic recording telegraph. Morse's mechanical arrangements were of little merit, and his alphabet and method of interpretation by a dictionary were clumsy and inconvenient. The chief point of interest in connection with the early history of the Morse telegraph was the proposal to make use of Sturgeon's discovery of electro-magnetism of soft iron. Morse, however, seems to have known practically nothing of the subject except that iron could be magnetized by a current, and in consulting his colleague, Dr. Gale, he was unwittingly led to use the discoveries of Henry, who had previously practically solved the whole problem. Much of the subsequent improvement in the mechanical arrangements were due to Vail, who became associated with Morse, and the Morse code as we now know it was almost, if not entirely, worked out by Vail. Considerable dispute and some litigation arose over Morse's claims, but that is outside our

present subject. There is no doubt that the electric telegraph was a slow-growth invention, with a view to pecuniary and other advantage, being ever ready to lay hold of each scientific discovery and try to turn it to account. The question who first conceived the idea can never be satisfactorily answered.

After 1840 there is little to record of a purely electrical character bearing only on telegraphy, but there have been many very ingenious mechanical contrivances introduced for recording signals, for reproducing pictures and handwriting and for printing, for duplexing, quadruplexing and multiplexing telegraph lines, for increasing the rate of signaling and in many ways increasing the expedition with which messages can be sent. Of course, the success of many of these contrivances, and even their invention, depended upon an increased knowledge of the laws of electricity and magnetism. For example, effective duplexing, quadruplexing, etc., depends on a proper understanding of the electrostatic capacity of the line, and this was not understood properly until the mathematical investigations of Thomson and others cleared the matter. For the impetus towards discovery in this direction again we are largely indebted to telegraphy, for much of that class of work was suggested by the difficulties encountered in signalling through long submarine cables.

The invention of the telephone is fast becoming ancient history, and yet it will always mark one of the greatest of the useful applications of electricity. It does not call for more than a passing remark here, because electro-magnetically it is all in Faraday's and Henry's papers.

The radiophone should be mentioned because it marks the application of the discovery, by May and Smith, of the effect of light on the resistance of selenium. This effect has since been found in the case of a large number of other substances, but it is still an interesting field for research. A number of experiments on this subject have been associated with attempts to make things visible at a distance. No doubt it will ultimately be possible not only to talk to a distant party, but also to see the party talked to, and thus, as it were, look the party with whom you are conversing in the eye.

THOMAS GRAY.

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*(To be concluded.)*

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## *THE PROVINCE AND PROBLEMS OF PLANT PHYSIOLOGY.**

THE exploitation and survey of the flora of our continent is a task of such tremendous magnitude that it has consumed the greater portion of the energy of American botanists until within a few years of the present time. The constantly increasing number of workers attracted to the subject has made possible not only a more thorough organization of the interests of taxonomic botany, but has also permitted a great deal of attention to questions of general morphology and cytology. Within the last decade an awakening interest has been shown in subjects in the physiology of plants. This interest has been manifested by the introduction of physiological matter in the text-books on botany, by the organization of courses of instruction in this branch in some of the more prominent colleges and universities, and by the accomplishment of investigations of more or less importance.

Any subject is liable to misconception and misapprehension during the earlier stages of its introduction into any country, and plant-physiology in America is no exception to the probability.

A misapprehension of a subject is likely to be followed by a perversion of the facilities devoted to it, the neglect of its

* Read before the Minnesota Academy of Science, December 30, 1897.

real and intrinsic phases, and finally, by the suppression of needed investigation in regions of the subject less fully developed. Furthermore, the distortion of the true nature of any branch of biological science is a misfortune which is bound to confuse thought and retard the progress of research. Misconceptions as to the true nature of a subject, on the part of workers engaged in it, are all the more dangerous since their expressions have the form and force of 'authority.'

A review of the courses of study, general addresses and recent publications dealing with the nature and limits of physiology, presented by American botanists is not at all reassuring. Many botanists harbor the preposterous opinion that the chief work in this subject has been accomplished in the thirty years in which active and continuous investigation within its limits have been in progress in the laboratories of the world. The persons in charge of botany in a number of institutions, in response to the demand for instruction in this branch, have labeled a course of section-cutting and reference reading 'plant-physiology,' and give the student no opportunity to acquire a knowledge of plants by actual experimental methods. If rarely he is afforded the opportunity to deal with the living plant under natural conditions it is to repeat some classic demonstration with a piece of stock apparatus to 'confirm' the results detailed in a text-book. The worst misapprehension of the subject is likely to occur in pure lecture courses based upon the text and reference books by 'readers' who have no part or interest in current investigations. Such courses are necessarily devoid of even the classic demonstrations, and the didactic character of the work quite naturally leads the student to the opinion that the subject is a closed one, and that the principles retailed him are not likely to be disturbed by future happenings.

That this state of affairs is by no mean imaginary is to be seen by the following quotation from a recent address by Dr. George Stone, in which he says: "One institution that I have in mind has advertised for years a thorough and complete equipment for work in vegetable physiology, and yet this same institution has scarcely had a single piece of purely physiological apparatus in its outfit in the whole time. The institution I refer to by no means stands alone in this matter."

The agricultural institutions have almost wholly neglected this subject of physiology, although "it is that branch of botany which has the closest relationship with all horticultural and agricultural knowledge and practice. In fact, it is the very foundation of these branches." "At the same time, we have been content to teach agricultural botany in our colleges for years, without considering it necessary to give the student any more than an elementary course in morphology, followed by flower analysis and the gathering of a herbarium, with a little histology thrown in."

The inattention to the physiological features of plant life is even more evident among experiment station workers, in the opinion of the author cited above: "There is no class of publications which shows such lack of physiological knowledge as from these, and it is shown by botanists, horticulturists and chemists as well. Their experiments frequently show that they know nothing about the functions of a plant or the factors which determine variation." The few exceptions to these statements are so well and widely known that they need no enumeration here.

In view of the above conditions, it is evident that any discussion which will bring the facts of the case into notice among American students will be of value.

Briefly stated, plant-physiology is concerned with the fundamental properties of

the protoplasm of plants, and the functions of the organisms into which it is formed. It is, therefore, a study of activities and regards structures from the standpoint of efficiency or functional value, and it includes the consideration of all reactions of growth, movement, metabolism, changes in form, irritability and other phenomena resulting from the activity of forces internal to the plant whether set in motion by internal or external stimuli. It merges into morphology in the subjects of growth and reproduction upon the one hand, and upon the other it underlies a portion of the domain of ecology, in the consideration of adaptative reactions, while with bacteriology and mycology it forms the basis of the study of pathology. Physiology and chemistry join in the consideration of the chemical activities and products of the organism, and the principles of physics are involved in the investigation of the plant machine.

It is not possible, nor would it be profitable, to separate the botanical branches too sharply in instruction or research. Some exposition of the principal functions of plants might well accompany an elementary course in morphology, and it goes without saying that a knowledge of anatomy is a prerequisite to the successful comprehension of the physiology of an organism, although some knowledge of the general principles may be obtained without it. Then again, it will often be found most profitable to extend work in physiology to include an interpretation of the more prominent adaptations, especially those of an ontogenetic character. To attempt to deal with such phases of plant life in instruction or research without a comprehension of the physiological principles involved is pure assumption.

In agricultural colleges and experiment stations the botanical problems and courses of foremost importance would be those dealing with nutrition and plant diseases. In this instance the work of the physiologist might well extend to cover almost all of the field of the pathologist.

The opinion that the main principles of physiology have been determined, and that only their minor and incidental application await delineation at the hands of the investigator, has been expressed concerning several subjects so many times in the last century that it needs no further notice at this time.

A systematic survey reveals the fact that, instead of a complete and thorough plotting of the great field of physiology, we have made here and there a few simple trails through the dense jungle of ungrouped and vaguely defined principles, and the greater part of the work is yet to be accomplished.

The fundamental problem of the constitution of living matter still confronts us. It is quite true that the chemical structure of its chief constituents, the proteids, is not yet determined, but even when this shall be known and the synthesis of this difficult group be accomplished we shall be but a step on the way, for there will still lie ahead of us the unknown physiological characters of the physical basis of life. Indeed, we may not say that we have determined even the limits of the gross anatomical existence of living matter, since there may well be stages of living matter or classes of organisms which so far have eluded our optical apparatus.

We have not yet succeeded in interpreting clearly even the cruder visible phenomena of the cell. The causes, character and purposes of cytoplasmic movement, the inter-relation of the organs of the cell, the nature of the activity of the plastids, the functional value of the nuclear constituents, and the operative relation of the protoplast to its membrane, are still open questions, while nothing but the crudest diagram of

the chemical activities of the cell is possible. The very apparent interprotoplastic threads have so far received no conclusive interpretation. Protoplasmic substance itself may wander from cell to cell, water, nutritive material, irritable or regulatory impulses may traverse these convenient pathways, but so far it has not been demonstrated that the structure in question is necessary for any of these functions.

The oldest branch of the subject is that of nutrition, and the beginnings of chemistry were made in researches upon the relation of the plant to the soil and air. The necessity and method of absorption of mineral salts and carbon dioxide is fairly understood, but the specific uses of the former and the manipulation of both classes of substances within the plant is unknown. Thus, for instance, the formation of food in the leaf from carbon dioxide and water is regarded as a photosynthesis, yet nothing is known of the process except that at an advanced stage a complex carbohydrate is produced. It is quite within the range of possibilities that the same products may result from a photosynthetic action on other carbon compounds. The composition of chlorophyll and its relation to the chloroplast are still in question. It may be lodged in interstices of the living matter or may form organic union with it. The chlorophyll may act as a converter of light into energy made available to the chloroplast, or its molecules may act as carriers in the synthesis. It is becoming even more open to doubt as to whether the activity of chlorophyll is exactly coincident with its absorption bands. Investigation in several lines must cooperate to solve this problem. The chemosynthetic activity of the nitrobacteria, and the thermosynthetic and electrosynthetic processes of other organisms, are hardly so well known.

The acquisition of nitrogen is a much vexed question, and the dawn of new investigations threatens to upset long cherished ideas as to the relation of the 'autophytes' to organic substances. The use, formation into crystals, resolution and transference of mineral substances in the plant body, is not satisfactorily explained. The balance and combined action of the several mineral elements in the soil is a matter of which we have no definite comprehension. Are the salts presented to the plant in commercial fertilizers absorbed as such and used as food, or are they subjected to synthetic activities, similar to those of the chlorophyll apparatus? Thus the presence of sodium salts in the soil is a benefit, amounting to a necessity in some instances, although this abundant element does not actually enter into the composition of protoplasm or plastic substance. The translocation, storage and formative selection of reserve material is bound up with that of fermentation, and the physiologist has progressed so far as to know that the preparation of reserve material, fluid and solid, for transportation is accomplished by means of ferments. He has isolated a few of these enzymes and has come to know that scores of others exist with action and chemical constitution unidentified. The vitalistic theory of fermentation will doubtless lurk among the residua of unexplained enzymic activities for many years to come. Indeed, the recent failure to extract a ferment from yeast gives the hypothesis a new lease of life. No doubt can exist, however, that the vital or regulatory action of the organism does play a part in these phenomena which we are not prepared to appreciate, and the secretory action concerned here and elsewhere in the plant has not received a fraction of the attention given such functions in animals.

The paucity of information of the physiologist concerning the alkaloids, glucosides, pigments and other compounds in the plant

is accented by the efforts made to explain the formation of these substances in a speculative manner upon ecological grounds.

So far as general metabolism is concerned it is to be said that the physiologist locates a substance here and there in the cell as a product of general processes, but he is incapable of more than ill-defined theories as to the course of chemical changes. It could scarcely be otherwise with the structure of the chief components of protoplasm unknown. The meager facts and abundant differences of opinion concerning the contents of resin ducts, laticiferous tissue and 'excreta' in general may well lead us to hesitate in declaring these subjects 'closed' and fixed.

The ascent of sap is a problem which has defied the combined efforts of the physicist and the physiologist for more than a century, and the results obtained by several of the most reliable investigators in the last decade have only annihilated previous hypothesis. In such manner capillarity, imbibition, the intermittent activity of protoplasm, the Jaminian chain, the lifting power of transpiration, variations in tension of enclosed gas-bubbles, and recently the tensile strength of a column of water, have each in turn held the place of importance only to give way to the inexorable logic of fact. It is generally admitted that the imbibition method proposed by Sachs is the only known method by which water *could* actually attain the summit of a tall tree, and that this method *would* furnish only a minute fraction of the amount necessary. On the other hand, it is well known that the current does not travel in the walls, but in the lumina and pits of the tracheal elements. We shall be compelled to return to the living elements and begin the investigation anew.

Time does not suffice to relate the detailed problems of growth yet unsolved, but it is becoming more and more evident that molecular features of growth are hardly at all determined, as well as the relation of this process to correlative and environmental forces.

The consideration of the effect of physiological factors, such as nutrition, light, etc., upon development and stature promises results of sweeping importance to all branches of biological science, if the few contributions which have appeared in this department may be taken as an index.

The nature of the irritability of plants, its development from the primitive reactions of protoplasm, the mechanism of reaction and transmission of stimular resultants, and the general irritable organization of the vegetal organism are yet hardly touched upon. In fact, so little understood is the sensitiveness of plants that biologists in general stand aghast at the daring of those investigators who seek to reduce it to terms comparable with those used in the description of animals.

As a specific case of incompleteness it may be mentioned that the path or conducting body for impulses in plants has not been determined in any single instance, nor has any cohesive theory as to a method of transmission ever been propounded. One may readily imagine the condition of animal-physiology if all information concerning the nervous system were wiped out of existence, and it would be known that the arm was moved by changes in form of lumps of tissue in that organ, which were set in motion when stimuli were applied to some distant organ with no apparent connection with the muscle.

The subject of reproduction has hitherto necessarily been considered from a purely morphological standpoint, although hundreds of titles of contributions upon the subject wrongly denote a physiological treatment. The time seems ripe for the physiologist to carry on researches upon the activities concerned, and some few splendid

contributions upon this phase of the subject are beginning to appear.

Lastly, it is the opinion of the writer that the physiologist has not yet entered upon the greatest task awaiting him, in the translation of the forms of activity shown by the vegetal organism into a system of general physiology, establishing a secure basis upon which coordination of accrued results may be made, a consequent better organization of the forces of attack upon waiting problems, and a more perfect articulation with all branches of biological science secured. The fact that this has not been accomplished is in part accountable for the nebulous ideas concerning the scope and status of the subject among even the botanical contingent.

In conclusion, it is to be said that it is manifestly impossible to do more than outline the developing principles which constitute the science of physiology, and suggest a few of the great gaps which remain to be filled by the efforts of future investigators. Moreover, the constant broadening of the biological sciences will demand a projection of physiological activity to cover widely diverging branches, and the interpretation of forms of activity of protoplasm yet unknown or but dimly recognized.

[Since the paper as above was prepared for the printer, Professor Loeb, in a discussion of the fundamental problems of animal physiology in this JOURNAL (Vol. VII., p. 154, 1898), has called attention to certain facts showing that the fundamental problems in the two branches are in part identical and in part closely parallel. His estimate of the outlook, "At no time since the period following the discovery of the law of conservation of energy has the outlook for physiology appeared brighter than at present," applies to this entire department of biological science.]

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*THE MOUTH-PARTS OF THE RHYNGOTA.*

Two papers on the above subject have been published within the last year or two, showing that there is yet a very considerable difference of opinion as to the real homologies of the beak and four inclosed lancets which form the Hemipterous mouth. The first of the papers in point of time and very much the most important is by Dr. Richard Heymons, in the *Ent. Nachr.*, XXII., 11, for 1896; the second is by Dr. N. Leon, *Zool. Anz.*, XX., 73, March, 1897.

Dr. Leon carefully describes the beak in several species of aquatic Hemiptera and particularly two little processes from the tip of the second (third) joint, which he homologizes with the labial palpi. It is to be noted that both Leon and Heymons assume it as unquestionable that the beak is a modified labium. In support of his thesis Dr. Leon shows that by proper manipulation the original paired character of the beak becomes evident and he makes the basal joint homologous with the submentum (labial cardines); the second with the mentum (labial stipes), and the third and fourth with the glossa and paraglossa. There is some confusion in the descriptions and in *Gerris* the third joint is made mentum without explanation. The chief point of the paper, however, is in the identification of the two little lateral processes from the so-called mentum as true labial palpi.

I have seen these same processes and would be inclined to consider Dr. Leon's arguments sound, if I did not believe the fundamental assumption that the beak is labial to be incorrect.

Dr. Heymons dismisses these processes from embryological data in the conclusion that 'labial palpi, consequently, are lacking in all *Rhyngota*. The processes discovered on the beak of *Nepa* and *Belostoma* are not really such, but must be regarded as a secondary process of the third joint of the beak.

This paper by Dr. Heymons, based on embryological data, is, however, very important when carefully studied, though in some respects the assumption that the beak is the labium has led, in my opinion, to false conclusions. After disposing of Kræpelin's contention that the inner and partly united pair of lancets represent the mandibles, he states, as his first proposition, that the lateral lancets are produced from the mandibles, which are peg-like, and are withdrawn into the head. This is modified in the seventh proposition, in which it is stated that the so-called mandibles are really only the lobes of the mandibles, of which the stem has become rudimentary. Yet, further, it is limited in the eighth proposition that in the Heteroptera, finally, the mandibular stem is entirely lost and united to the anterior part of the juga; but as this leaves an unattached lancet floating about, we find in the fourth proposition that in the Heteroptera the maxillary stem is usually divided into two parts. On one, which I call lamina maxillaris, occurs the musculus protractor of the lateral lancets (mandibles). Differently stated, this means that a peg-like process is identified as a mandibular lobe whose stem disappears, which is retracted into the head, where it forms a lancet whose musculus protractor is attached to the stem of the maxilla! Now a lobed mandible is a rarity in insects, and where a lobe does occur it is either an insignificant appendage or is firmly united to the base. An absence of the lobe is the rule, everywhere; in no mandibulate is the lobe ever the only part represented. Here we are supposed to see the stem disappear and the lobe developed into an appendage attached to the maxillary stem.

If the musculus protractor is attached to part of the maxillary stem, which I have no doubt is the case, why not consider the lancet maxillary, and as lacinia, or inner lobe? This would make its attachment and association perfectly normal. Does it not seem just a little absurd to claim that such organs as the mandibles can become practically maxillary appendages?

The second proposition is that the median (inner) lancets are not made up by the maxillæ in toto, but only by their lobes, which are also peg-like and retracted into the head. The third proposition is in part that the trunk of the maxilla after the retraction of the lobes agrees in essentials with the palpi maxillaris of other insects. That is exactly what it ought to do if the lancet is the produced palpifer which I believe it to be.

Dr. Heymons proves, therefore, to my mind, that one pair of lancets is palpifer from the maxillary palpi, the other lacina from the stem of the maxilla; and this is exactly the conclusion which I reached from comparative studies. The muscles from both lancets are supplied from maxillary structures exclusively.

The fifth proposition is that 'rudimentary maxillary palpi are recognizable at the roots of the beak'. In Nepa, for instance, they are approximately onion-shaped and placed before the juga. This it seems to me indicates that the beak is also maxillary, but the ninth proposition is that the beak is derived from the third (hinder) embryonic pair of jaws. The development teaches that in the Rhyngota this pair remains simple. On the labium neither palpi nor lobes, nor any structure that may be considered such, occur. Labial palpi, consequently, are lacking in all Rhyngota.

If these embryonic processes forming the beak are really those of the labium, would not the entire absence of lobes or appendages be an unusual character? Assuming them to be, as I believe, the maxillary galea all difficulty vanishes.

The truth is, Dr. Heymons started with the conviction that he must find three em-

bryonic pairs of jaws, and he found three pairs of processes, which he so identified. Now I have shown elsewhere that the maxillæ are formed of three lateral parts, each of which may be distinct and has its own range of variation; and if we assume that the three pairs of processes observed by Dr. Heymons are all maxillary the Hemipterous mouth becomes quite clear and the attachments of the lancets and the location of the rudimentary maxillary palpi at the base of the beak is normal.

I have previously expressed my belief that the Rhyngota are not descended from a mandibulate stem and that they separated from the archetypal form before the mouth structures were definitely formed anywhere. They were emandibulata from the start, and as such are now equivalent in rank to all the other orders of insects (excluding Thrips) combined. Nor was any labial structure ever developed in this order, and all trace of such is now lost, in the adult at least.

If we study Dr. Heymons' paper in the light of these suggestions it is the most important contribution to our knowledge of the mouth parts of the Rhyngota that has recently appeared.

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*THOMAS JEFFERY PARKER.**

Thomas Jeffery Parker, who died at Warrington, New Zealand, on November 7, 1897, was the eldest son of the late William Kitchen Parker, F.R.S., the world-renowned comparative osteologist. He was born in the S. W. district of London on October 17, 1850, and educated there, and his scientific training was received at the Royal School of Mines during the years 1868–1871. Leaving that institution with distinction, Parker became science master at the Bramham College, Yorkshire; and Mr. W. B. Lockwood, now assistant surgeon at Bartholomew's Hospital, London, may be named, as an anatomist who in his schoolboy days came under his influence. In 1872, at the special request of Huxley, Parker returned to London, to fill the office of demonstrator of biology at the then newly established Science College at South Kensington, now known as the Royal College of Science, London, and he held the post until his appointment, in 1880, to the professorship of biology at the University of Otago, Dunedin, New Zealand. As a teacher Parker will remain memorable in association with the development of the now universally adopted Huxleian method of laboratory instruction in biology, known and recognized throughout the world as the 'type system,' which marked the introduction of rational methods into the teaching of biological science. So earnestly did Parker enter into the task of development of this under his great master that he early became the means of effecting conspicuous changes in its methods, and he will be remembered in history as the man to whom were mainly due its progress beyond the experimental stage and the foundation, in connection with it, of the first teaching-collection of specimens and illustrative anatomical drawings based upon it—the prototype of all since established in various parts of the world.

Among Parker's published works there stands conspicuous his 'Zootomy,' a didactic laboratory treatise, and his 'Lessons in Elementary Biology,' now translated into German, a book for the study and the fireside. Both take high rank among scientific manuals in the English language and both were the direct outcome of his connection with Huxley and his educational work, and the last-named takes rank as the most important treatise for the elementary student that has appeared since

*From the *Anatomischer Anzeiger*.

Huxley and Martin's epoch-making 'Practical Instruction in Elementary Biology.' To read this book, and a charming biography of his father which Parker published in 1893, is to realize the warmth and affection of his nature, the strength of his character, the breadth of his attainments as a philosophic teacher and his command of literary style. In these and all respects Parker's was a charming character. As a companion he was loyal and affectionate, as a worker painstaking and reliable, a friend of youth, utterly destitute of ostentation and false pride, withal an exemplary man; and among those who during the period of his association with Huxley and his great work as a teacher came under his charge and benefited by his example may be mentioned F. E. Beddard, Angelo Heilprin, H. F. Osborn, W. B. Scott and Oldfield Thomas, among well-known zoologists and anatomists.

As an investigator Parker published some forty odd papers and monographs, the best known of which are those dealing with the 'Structure and Development of Apteryx' and the 'Cranial Osteology, Classification and Phylogeny of the Dinorithidæ,' sufficient in themselves to have made him famous. On settling down in New Zealand Parker early published a short paper on a new species of Holothurian (*Chirodotes Dunediensis*), as it were in anticipation of the later resolve by him and his colleagues, who were during the early 80's appointed to the Australasian professorships of biology, to preferably investigate their indigenous fauna, leaving the refinements of histology and the like for those at home. The results of the combined labors of these men are now monumental. Their work is now saving from oblivion a knowledge of things rapidly passing away, and there will ever remain memorably associated with the desire to create a sustained interest in a series of short 'Notes from the Otago University Museum,' which Parker during the seventeen years he was in New Zealand contributed to the pages of *Nature*, and of 'Studies in Biology for New Zealand Students,' which he instituted and which his pupils and co-workers maintained. Apart from this special interest, as involving the investigation of the Australasian fauna, Parker's published works cover a wide field. Vertebrates and Invertebrates alike came under examination, and in his series of papers on the anatomy of the Crayfishes, which culminated in a contribution to the 'Macleay Memorial Volume,' published in 1893 conjointly with his pupil, Miss Josephine Gordon Rich, there can be traced interesting continuity of ideas, and once again a primary association with Huxley, in the preparation of whose zoological masterpiece, 'The Crayfish,' Parker performed an honorable service.

The duties of office in New Zealand imposed upon Parker the Curatorship of the Otago University Museum and the conduct of a botanical class. Before leaving England he had established a reputation as a pioneer in the application of modern dry methods of micro-chemical technique to the study of vegetable histology, in a noteworthy paper read before the Royal Microscopical Society of London during March, 1879, and shortly after the commencement of work at the Antipodes he announced (Trans. New Zealand Institute for 1881) the discovery of sieve-tubes in the marine Algæ (*Macrocystis*). While for the latter Parker's memory will find a place in the history of botanical discovery, in the performance of his curatorial duties he will be remembered as having most successfully overcome the difficulties of preservation of the cartilaginous fish skeleton in a dry state, as may be witnessed in that of a large *Carcharodon* preserved in a British Museum of Natural History and in others at Otago, Cambridge and elsewhere.

In 1892 Parker paid a visit to Europe, returning in good health the following year. Family bereavement in the death of his wife then overtook him and laid the foundations of an illness from which he never recovered. Complicated by repeated attacks of influenza, this resulted in death, and during his long period of suffering and anxiety the like of which has killed many a man, he worked on undaunted, leaving unfinished an elementary book to have been entitled 'Biology of Beginners,' and some observations upon a series of 'Emen Chicks,' including those collected by Professer R. Semon during his recent sojourn in the Australian bush, which he was investigating in conjunction with Mr. J. P. Hill, the renowned discoverer of the allantoic placenta of *Perameles*. With these and other plans for future work well matured he has been cruelly torn from us, but while his memory will be a lasting heritage to those who knew and loved him, to the scientific world at large there has just been issued his final completed work, viz.: a general Text-Book of Elementary Zoölogy of some 4,000 pages in two volumes, upon which during the last 5 years he was engaged, together with his staunch friend and colleague, Professor W. A. Haswell, F.R.S. of the Sydney University. In this book, rich in original anatomical drawings, his influence will endure; and he will always be remembered as an earnest, loving man who performed his duties with a skillful hand, intent only on good work, the advancement of knowledge and the consequent betterment of the human race, an anatomist for whose life the world may be said to have been the richer and his fellow creatures the happier.

Parker was a Fellow of the Royal Society and a D. Sc. of London. He was also an Associate of the Linnæan Society of London and member of other scientific societies at home, in the Colonies and on the Continent of Europe. He took a pioneer's part in the literary undertakings of the Royal Microscopical Society, and in his public life by his miscellaneous addresses and speeches he aroused to admiration and friendship all with whom he came in contact.

G. B. H.

### *A COMMISSION OF PUBLIC HEALTH.**

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That there shall be established a commission of public health, to be under the supervision of a commissioner of public health, who shall have the aid of an advisory council consisting of a representative from each State and Territorial board of health, from the Department of Justice, and from the Medical Corps of the United States Army and Navy, the duties of which shall be to collect and diffuse information upon matters affecting the public health, including statistics of sickness and mortality in the several States and Territories; the investigation by experimental and other methods of the causes and means of prevention of disease; the collection of information with regard to the prevention of disease; the collection of information with regard to the prevalence of infectious, contagious and epidemic diseases, both in this and other countries; also the causative and curative influences of climate upon the same; the publication of the information thus obtained in a weekly bulletin; the preparation of rules and regulations for securing the best sanitary condition of vessels from foreign ports, and for prevention of the introduction of infectious or contagious diseases into the United States, and their spread from one State into another; which rules, when approved by the President of

* Abstract of a bill introduced in the House of Representatives, February 17, 1898, by Mr. Otjen, Representative from Milwaukee, Wis.

the United States, in so far as they are consistent with the existing laws, shall be adopted and enforced as quarantine regulations at the various ports of entry in the United States, and so far as applicable to interstate commerce, to prevent the spread of disease from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia, shall be and become additional regulations thereof; the advising and informing the several departments of government on such questions as may be submitted by them to it, or whenever, in the opinion of the commission, such advice and information may tend to the preservation and improvement of the public health.

SEC. 2. That the commission of public health shall be under the control and management of a commissioner of public health. Said commissioner of public health shall be appointed by the President of the United States, by and with the advice and consent of the Senate, and his term of office shall be six years; he shall be a regularly educated physician holding a diploma legally conferred upon him by a legally incorporated medical college in the United States; he shall have had at least ten years' experience in the practice of his profession, and shall be learned in sanitary science, and shall hold a membership in one or more reputable sanitary or medical societies or associations in the United States.

SEC. 3. That the commissioner of public health may appoint an assistant commissioner of public health, who shall be a physician of good standing in the medical profession and skilled in sanitary science.

SEC. 4. That the commissioner of public health shall annually, on the second Tuesday of January of each and every year, and at such other times as he may designate, call to meet in the city of Washington, District of Columbia, an advisory council, to be composed of the commissioner of public health, the assistant commissioner, an officer learned in the law, detailed by the Attorney-General of the United States from the Department of Justice; officers from the Medical Corps of the United States Army and Navy, each to be detailed by the respective Surgeons-General thereof, and a representative from each State and Territorial board of health.

SEC. 5. That the commission of public health hereby created shall be provided by the proper governmental authorities with proper offices in the city of Washington, District of Columbia, said offices to be supplied with proper fixtures, laboratories and all needful apparatus and property; that the service known as the 'Marine-Hospital Service' shall be transferred to the said commission of public health hereby created, and shall be known as the 'Bureau of the Marine-Hospital Service;' and all laws governing the appointment to official positions in said Marine-Hospital Service, and to promotions in said service, shall continue in full effect, it being the intent and purpose of this Act to continue the Marine-Hospital Service in the performance of the duties for which it was lawfully created, and for such other duties as may be legally prescribed.

SEC. 6. The consular officers of the United States, at such ports and places as shall be designated by the commissioner of public health, shall make weekly reports to the commission of the sanitary condition of the ports and places at which they are respectively stationed; and the commissioner of public health shall also obtain, through all sources accessible, including State and Territorial sanitary authorities throughout the United States, weekly reports of the sanitary condition of ports and places within the United States, and shall prepare, publish and transmit to collectors of customs, and to State and Territorial boards of health, and through them to municipal

health officers and other sanitarians, weekly abstracts of the consular sanitary reports and other pertinent information received by him, and shall also, as far as he may be able, by means of voluntary coöperation of State and Territorial health authorities, and through them, municipal health authorities, public associations, and private persons, procure information relating to the climatic and other conditions affecting the public health.

Sec. 7. That a special report of the said commission of public health, relative to such action as will most effectually protect and promote the health of the people of the United States, may at any time be required by the President of the United States.

Sec. 8. That the commission shall cooperate with State, municipal, and local boards of health in establishing and maintaining an efficient and accurate system of notification of the existence and progress of contagious or infectious diseases, and of vital statistics in the United States.

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## *CURRENT NOTES ON ANTHROPOLOGY.*

### CAN SEX BE DISTINGUISHED IN SKULLS?

Enthusiastic osteologists frequently assert that they can distinguish the sex by an examination of the skull. It is possible, when one is familiar with many skulls, from the same stock and geographically limited to narrow bounds, that this can often be accomplished. But in general it is not possible. There is no sex-criterion in the skull.

In an inaugural dissertation, published in Berlin last year, and noticed in the *Centralblatt für Anthropologie*, January, 1898, Dr. Paul Bartels submitted the question to a new and searching examnation, founded on 1,090 skulls—685 male and 405 female. He could discover no positive characteristic of sex. The fossa-typanico-stylo-mastoidea, of which much has been made, he shows to be inconclusive; and the same is true of every other trait which has been advanced as a determination of sex.

### THE EARLIEST ITALIANS.

One of the numbers of the 'Piccola Biblioteca delle Scienze Moderne,' published by the Brothers Bocca, at Turin, is a treatise by Professor Sergi on the earliest inhabitants of Italy (Arii e Italici, pp. 229, illustrated).

The author's theory may be briefly stated. The oldest tribes on the peninsula, the Pelasgians and Ligurians, belonged to the 'Mediterranean' stock, which at a remote date moved northward from equatorial Africa. The Aryans entered much later, coming from the north, and originally from Asia, bringing with them the Umbrian, Oscan and other Indo-European dialects. The Etruscans, of unknown affinities, but members of the 'Mediterranean' stock, entered by sea, on the west coast, about 800 B. C., arriving from the eastern Mediterranean shores.

The author bases most of his argument on cranial forms, but also discusses with some detail the archæologic evidence, and slightly that derived from language. It is unnecessary to point out how many obstacles present themselves to such a solution of this intricate question.

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## *NOTES ON INORGANIC CHEMISTRY.*

The *Chemical News* published two papers by Professor William Ramsay and Dr. Morris W. Travers before the Royal Society on January 20th. The first is on the homogeneity of helium. In a previous paper recently noticed in this column an account was given of an attempt to separate argon and helium into two portions of different densities, by diffusion through pipe clay. These experiments showed that while it did

not appear possible to thus separate argon into two gases there was more promise of success with helium. This experiment has now been carried out on a much larger scale with helium, and, while the gas is thus readily separated into a lighter and a denser portion, it is found that while the lighter portion is pure helium (density = 1.98), the denser portion is a mixture of helium with a small quantity of argon. The most careful experiments fail to show a trace of any new gas. It appears that every mineral which contains helium also contains a varying proportion of argon, with the exception of some cleveite from which argon is almost wholly absent. The gas from malacone, on the contrary, contains a larger proportion of argon than of helium. Professor Ramsay discusses the probability of the existence of a third gas, with an atomic weight of about 20, lying between helium —4 and argon —40. Such an element would correspond to the second element in each of the seven groups of the periodic system —chlorin, sulfur, phosphorus, etc. According to this view helium and argon would be respectively the first and third elements of the eighth group. It is true that argon has a higher atomic weight than the next following element, potassium of group first, but it is also true that cobalt appears to have a higher atomic weight than the following element, nickel, and tellurium than iodin. Professor Ramsay has hopes that the element with atomic weight 20 may yet be found among the gases evolved from some mineral and is continuing his search.

THE second paper mentioned is on Fergusonite—an endothermic mineral. This mineral is mainly a columbate of yttrium, with seven per cent. oxids of uranium. It also contains helium, and on heating to 500°–600° it suddenly becomes incandescent, evolving much of its helium, while its density decreases. The evolution of heat for a gram of the mineral was found to be 809 calories. The explanation of these characteristics seems to be that the mineral is a true endothermic compound of helium. At least two other minerals, gadolinite and æschinite, exhibit endothermic properties, but they increase in density on ignition, the cause being possibly polymerization, and hence they cannot be classed with fergusonite. Only the æschinite contains helium, and that in very small quantity. Professor Ramsay suggests that possibly these minerals, containing the rare elements, represent a portion of the interior of our planet, and their formation a condition of our earth realized only before solidification set in. Under the enormous pressure obtaining at the center, combination with helium was an exothermic event. Such compounds, in some unexplained manner having come to the surface where they are no longer exposed to pressure, have in consequence become endothermic. "The frequency of the helium spectrum in the stars and its presence in the sun makes it less improbable that some such explanation may not lie far from the truth."

IT was noted last week that E. Sonstadt had shown that platinum tetrachlorid is decomposed on boiling in very dilute solution, with the formation of platinum monochlorid, PtCl. He now shows in an article in the *Chemical News* that auric chlorid is similarly decomposed when heated in very dilute (1:15,000) solution, with the deposition of metallic gold. He supposes aurous chlorid, AuCl, to be first formed analogous to the case with platinum, but this decomposes into metallic gold and auric chlorid, hence only the metal is precipitate. Sonstadt considers that this is a general reaction for the higher chlorids of the metals of the platinum group.

J. L. H.

## SCIENTIFIC NOTES AND NEWS.

### THE FOURTH INTERNATIONAL CONGRESS OF PHYSIOLOGY.

An International Congress of Physiologists is held triennially, with the object of contributing to the advancement of physiology by affording to physiologists of various nationalities an opportunity of personally bringing forward experiments and of exchanging and discussing views one with another and further of making mutual personal acquaintance.

At the conclusion of the Congress at Bern, in 1895, it was unanimously resolved that the Fourth International Congress of Physiologists should be held at Cambridge, England, in the present year. The usual circular letter of the Executive International Committee, concerning the arrangements for and regulations of the Conference, will be issued shortly after Easter. Meanwhile, the National Organizing Committee for the Congress send the following information:

The Congress will open on Tuesday, August 23d, and will hold sittings on that and the three immediately following days. The place of meeting will be the Physiological Laboratory of the University. The sessions will be devoted especially to experimental forms of demonstration. At the last Congress Professor Foster was elected President for the forthcoming Congress. Professor Foster has kindly expressed his readiness to afford to members of the Congress all possible facilities for experimental demonstration, as well as for the exhibition of preparations and of scientific apparatus. Three languages are recognized as official at the Congress, namely, English, French, German. Each member of the Congress is required to contribute the sum of ten shillings towards defraying the expenses of the meetings. In receipt for that subscription a card of membership of the Congress will be issued by the Local Secretary, Dr. L. E. Shore, Physiological Laboratory, Cambridge.

Those who intend to be present and those who wish to present papers should address the Local Secretary, Dr. L. E. Shore, Physiological Laboratory, Cambridge, before July 4th.

In connection with the Congress, an Exhibition of Physiological Apparatus will be held. Exhibits may be contributed by members of the Congress, by directors of physiological laboratories, and by makers recommended by any member or director. The exhibition of apparatus will open on Monday, August 22d, and remain open for the five following days.

The national organizing committee consists of M. Foster, *President*; C. S. Sherrington, *Hon. Secretary*; F. J. Allen, W. M. Bayliss, T. G. Brodie, J. S. Edkins, W. H. Gaskell, F. Gotch, W. D. Halliburton, J. B. Haycraft, Leonard Hill, J. N. Langley, J. G. M'Kendrick, C. MacMunn, O. Noel Paton, M. S. Pembrey, J. M. Purser, P. H. Pye-Smith, Waymouth Reid, W. Rutherford, J. B. Sanderson, E. A. Schäfer, L. E. Shore, W. Stirling, W. H. Thompson, A. D. Waller.

### THE ALLEGHENY OBSERVATORY.

In order to retain the services of Professor James E. Keeler, who had been offered an important position in the Yerkes Observatory, steps have been taken at Pittsburg and Allegheny to build for him a new observatory with a thirty-inch telescope. It is to be hoped that the call of Professor Keeler to Lick Observatory, announced elsewhere in this issue of SCIENCE, will not interfere with the construction of a new observatory for the Western University of Pennsylvania. The present observatory is so surrounded by buildings and its equipment is so meager that it must be removed and enlarged if it is to maintain the rank given to it by Professor Langley and Professor Keeler. Allegheny City has given the University a site in an elevated position surrounded by parks and comparatively free from smoke, and the sum of about $100,000 has been subscribed towards the new building and its equipment. This sum, it is expected, will very soon be greatly increased. At the close of a course of lectures given at the Carnegie Library, Professor Keeler, as reported in the Pittsburg *Commercial Gazette*, referred to the need of a new observatory as follows:

"I desire to say a few words about a subject that should interest all very greatly. The object of this society is the diffusion of knowledge. It is well that we should found colleges and

societies and libraries to further this great purpose. But before the truth can be spread among the people it must be found; and a few men—a small minority of the world's population, but the leaders of the world's intellectual progress—are constantly engaged in pushing outward the boundaries of knowledge into the unknown. To one who knows that this minority exists and understands what it is, membership in it is one of the most enviable things that a man or an institution can win.

"Through the researches which Professor Langley carried on for years at the Allegheny observatory, we once had a high standing among the keen minds who are probing the secret places of nature, but the commercial activities of a great city have encroached upon the scene of scientific labor and the old observatory is shrouded in a pall of smoke. Its usefulness is at an end.

"We wish to build a new observatory. The city of Allegheny has reserved for us the excellent site in Riverview Park, two miles to windward of the present building, and practically free from smoke. Three years ago I drew a plan for an observatory to be placed upon this site. It provides for a thirty-inch telescope, an instrument which is large enough for the most advanced work, and yet not too large for convenience in operation, and all the accessory apparatus which the use of such a telescope requires. It also provides for a public department, with a thirteen-inch telescope, to which visitors will be freely admitted every clear night.

"The plan has been shown to a number of the most eminent astronomers in this country, and has met with their approval. The estimated cost is $175,000. In these two cities we have everything necessary to insure the successful carrying out of our purpose. Within a stone's throw of the observatory we have the best optician and instrument maker in the world. We have abundant wealth. All we need now is the will, and as some of our most eminent citizens are interesting themselves most unselfishly in the matter, I hope we shall not long want that. I ask all who wish to see Pittsburg an intellectual as well as a commercial center to lend us a helping hand."

## THE BIOLOGICAL LABORATORY OF THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

THE next annual session of the Biological Laboratory will be held at Cold Spring Harbor, Long Island, during the months of July and August, 1898. The regular class work will begin on Wednesday, July 6th, and continue for six weeks. The laboratory will be open for work from July 5th until August 27th. Special students may make arrangements for using the laboratory from the middle of September, or later, if desirous of doing so. Application for admission to any course, except Zoology 1 and Botany 2, should be made on or before June 15th.

The laboratory has now possession of several buildings: 1. A large laboratory, accommodating about sixty students and fitted with aquaria, running fresh and salt water, private rooms, library, etc. 2. A lecture hall, used both for class lectures and for public lectures. It is furnished with an oxyhydrogen lantern. In the basement of this building is a dark room for photographing purposes, equipped with cameras and arrangements for ordinary photography, microscopic photography, lantern-slide making, etc. 3. A dining hall used for boarding the party. 4. Two dormitories for students, one of them being assigned to men, and the other to women. The rooms in these dormitories are newly furnished and are rented to students for a small sum. In addition, the laboratory is furnished with a naphtha launch, small boats, collecting apparatus, bacteriological apparatus, books, and all small apparatus needed for carrying on laboratory work. A limited number of microscopes are furnished the students, although each person is urged to bring a dissecting and a compound microscope if possible. The laboratory has also the advantages of the aquaria and appliances of the neighboring hatchery of the New York Fish Commission. The laboratory fee, including any one course of instruction, the general lectures and the use of laboratory privileges, will be $20. For each additional course of instruction there is an additional fee of $5. Except in the courses in Zoology 1 and Botany 2, students not provided with compound microscopes of their own will be charged $5 for the use of a microscope. Board will be

furnished for $4.50 per week. Rooms in the dormitories cost $1.50 or $3.00 per week, according to size.

In addition to the regular courses of instruction popular lectures will be given, open to the members of the laboratory and the friends of the school. Professor Charles L. Bristol, of New York University; Smith Ely Jelliffe, M. D., of New York; Dr. George H. Parker, of Harvard University; Mr. Gerrit S. Miller, of the National Museum, Washington; Professor Richard E. Dodge, of the Teachers' College, New York, and Mr. D. S. Judge, of the United States Department of Agriculture, will be among the lecturers.

Full courses are offered by the following board of instruction: Charles B. Davenport, Ph.D., Harvard University, General Director of the Laboratory; Professor H. T. Fernald, Ph.D., State College, Pa., instructor in zoology; D. S. Johnson, Ph.D., Johns Hopkins University, instructor in botany; C. P. Sigerfoos, Ph.D., University of Minnesota, assistant in embryology; Professor W. H. C. Pynchon, Trinity College, instructor in photography; Nelson F. Davis, Ph.D., Bucknell University, instructor in bacteriology; Henry R. Linville, Ph.D., New York City High School, assistant in zoology; Mrs. Gertrude Crotty Davenport, past instructor in Kansas University, instructor in microscopical methods.

GENERAL.

Professor James E. Keeler, director of Allegheny Observatory, has been elected by the regents of the University of California director of Lick Observatory, to succeed Professor Edward S. Holden, who recently resigned, after twenty-five years' service.

The Imperial Academy of Sciences of St. Petersburg has awarded its Shubert prize, for the greatest work in theoretical astronomy, to Professor Simon Newcomb.

The laboratory of the United States Fish Commission Station at Wood's Holl, under the direction of Professor H. C. Bumpus, has been opened and a number of investigators are already at work. Men of science who wish to carry out research in the laboratory or suggest lines of investigation should communicate with the director.

Dr. Charles Wardell Stiles, of the United States Department of Agriculture, has been appointed attaché to the United States Embassy in Berlin. Dr. Stiles's duty will be to keep the Agricultural Department informed on important discoveries and other matters of interest to agricultural science, to defend American meats, fruits and other exports against unjust discrimination, and to advise the Secretary of Agriculture from time to time concerning the purity of the food products that are shipped from Germany to the United States. It is said that the appointment of Dr. Stiles will probably be followed by other similar appointments, and it consequently represents an important advance in the application of scientific principles to diplomatic and commercial affairs.

We regret to record the death, at the age of eighty-one years, of Sir Richard Quain, the eminent British physician and writer on medical subjects.

Mr. G. K. Gilbert, of the United States Geological Survey, gave a lecture on the history of the Niagara river at Vassar College on March 10th.

The London Physical Society has elected as honorary members Professor Riccardo Felici, of Pisa, and Professor Emilio Villari, of Naples.

At its meeting of March 9th the American Academy of Arts and Sciences elected Albert Heim, of Zurich; Friedrich von Recklinghausen, of Strassburg, and Ferdinand Brunetière, of Paris, as foreign honorary members.

Mr. G. J. Symons, F.R.S., has been presented by the Prince of Wales with the Albert medal of the Society of Arts for his services to meteorology.

A complimentary dinner was given in London on February 26th by his old students and friends to Professor M'Kenny Hughes, to celebrate the completion of his 25 years' tenure of the Woodwardian professorship of geology at Cambridge. Between 60 and 70 guests, many of them ladies, were present, including, in addition to old students, Sir Archibald Geikie, of the Geological Survey, who presided, and

Mr. W. Whittaker, President of the Geological Society. An illuminated address was presented in the name of the old students by Dr. R. D. Roberts and Mr. Strahan. Professor Hughes has also been presented with a loving-cup by his former students.

A BUST of the geologist Freiherr H. von Foullon, who was killed in the Solomon Islands in 1896, has been placed in the Geological Institute of the University of Vienna.

MAYOR VAN WYCK, of New York, has appointed Mr. Michael C. Murphy, a Tammany politician, to the presidency of the health board of the city.

THE Ninth International Congress of Hygiene and Demography will, as we have already announced, be opened at Madrid on April 10th and will be continued for one week. The exhibition of hygiene will, however, be open for three months. Scientific papers must be sent before March 15th. They may be written in Latin, Spanish, Portuguese, Italian, French, English or German, but must be accompanied with a short summary written either in Spanish or in French. The Spanish railways and steamship companies have made a reduction of 50 per cent. to all attending the Congress.

THE American Neurological Association will hold its twenty-fourth annual meeting on May 26, 27 and 28, 1898, in New York, at the Academy of Medicine.

THE Senate Committee on Commerce has authorized Senator Quay to report as a separate bill the amendment to the Sundry Civil Bill proposed by Senator Penrose in aid of the industrial exposition proposed to be held in Philadelphia in 1899. The bill appropriates $200,000 for a government exhibit and provides for the admission of foreign articles free of customs duties.

APPROPRIATIONS have been proposed in the Massachusetts Legislature giving $4,000 for a forest survey of the State and $2,000 for a survey of the lakes and ponds.

IT is reported that the Duke of the Abruzzi has had a conference with Captain Sverdrup on the subject of his projected expedition to the Arctic regions. The Duke will leave next summer for Spitzbergen in order to explore the country, but the expedition will not start until 1899, and its first objective will be Franz Josef Land. Should the conditions of the ice be favorable, depôts will be established, and an attempt will be made to reach the Pole by means of sledges and dogs. In the event of this, however, proving impracticable, the expedition will confine itself to an exploration of Franz Josef Land. On the advice of Captain Sverdrup, the Duke will ask the Danish government for a supply of dogs from Greenland, as these are considered to be the best.

THE *Evening Post* reports that the great painter, Mr. G. F. Watts, is an associate of the Society for the Protection of Birds, and feels strongly about the fashion of using the plumage of birds for millinery purposes. He is now painting a picture representing an angel with bowed head and despairing figure bending over a marble tomb covered with birds' wings, while a spirit of evil grins below.

THE publishing house of G. T. H. Fischer, Cassel, announces several new additions to its series of zoological charts prepared under the supervision of the late Professor Rudolph Leuckart and Dr. Carl Chun.

Subscriptions to the fund being collected as a memorial to the late Edmund Drechsel should be sent to Professor Kronecker, Bern, not Berlin, as given in a recent issue of this JOURNAL.

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## *UNIVERSITY AND EDUCATIONAL NEWS.*

THE will of the late Amos R. Eno contains several public bequests, including $50,000 to Amherst College.

MISS HELEN GOULD, New York, has given $20,000 to Rutgers College.

MR. ANDREW CARNEGIE has given $50,000 for a technical school at Dumferline, Scotland.

DR. GEORGE S. FULLERTON has resigned the Vice-Provostship of the University of Pennsylvania. He will retain the professorship of philosophy, but will take a year's leave of

absence for research in Europe. Professor Fullerton never intended to retain the Vice-Provostship of the University, and only accepted the position while the University was being reorganized after the election of Provost Harrison.

President Andrew S. Draper, of the University of Illinois, having declined the Superindency of the schools of New York City, Dr. W. H. Maxwell, Superintendent of the Brooklyn schools, was elected Superintendent on March 15th.

Of the three travelling fellowships annually awarded at Bryn Mawr College, two have been awarded in the sciences—the President's fellowship to Miss L. R. Laird, a student of physics, and the Mary E. Garrett European fellowship to Miss F. Peebles, a student of biology.

Mr. D. E. O. Lovitt has been elected assistant professor of mathematics in the John C. Green School of Science, of Princeton University.

Professor P. Hensel, Strassburg, has been called to an assistant professorship of philosophy newly established at Heidelberg.

Dr. George Treille has been appointed to the newly established chair of colonial hygiene in the University of Brussels.

The University of Göttingen will again this year offer, during the Easter holidays, courses in science for teachers. No charge is made for attendance on these courses.

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## *DISCUSSION AND CORRESPONDENCE.*

### THE LONGEVITY OF SCIENTIFIC MEN.

Professor Edward S. Holden contributes to the last number of the *Cosmopolitan* an article 'On the Choice of a Profession: Science 'intended to be' of distinct use to young men and women of the Cosmopolitan University.' In the course of the article occurs the following:

> Among the advantages of following science as a profession we must certainly reckon its undoubted tendency to prolong the lives of its votaries. It is not a little remarkable that men of science, astronomers among them, are particularly long lived. The average longevity of men is about thirty-three years. Some one has had the patience to determine the average age of some seventeen hundred astronomers and mathematicians, and it turns out to be sixty-four years! That is, astronomers live nearly twice as long as men in general. * * * I think no one can fail to be surprised at the foregoing statistics.

Professor Holden is certainly right as to the surprise likely to be awakened by these statistics. An exclamation mark or a question mark would perhaps be sufficient comment for scientific men; but for the benefit of the young persons of the Cosmopolitan 'University' it may be explained that none of the 1,700 eminent astronomers and mathematicians died when they were infants. We do not know the average age at which work was done that would entitle a man to be included in this list of astronomers and mathematicians, but if it were forty years, we know that the expectation of life for men of that age is (according to tables of the Institute of Actuaries) 27.4 years. The average age at death of ordinary men would then be 67.4 years and of the astronomers and mathematicians, 64 years.

J. McK. C.

### THE REVIVAL OF ALCHEMY—A REJOINDER.

In Science of December 10th Dr. H. Carrington Bolton makes personal mention of me and inferentially describes me as being an 'educated charlatan' and as having 'cracked brains.' He also says, inferentially, that I belong to a class of persons who 'wear their feather in their heads,' an expression that is not very clear to me, but I suppose implies something more and worse than the feat ascribed in popular song to Yankee Doodle. But, however, this may be, I presume that, as a matter of even-handed justice, space will be accorded me in Science for the following reply:

1. Dr. Bolton's characterization of me is either a simple expression of his opinion or a conclusion from premisses.

2. Opinions need to be weighed before acceptance. Dr. Bolton says that "Sir Isaac Newton dabbled with furnaces and chemicals in true hermetic style; and Leibnitz showed the courage of his convictions by acting as Secretary of an Alchemical Society in Germany," and, further, that "so eminent a chemist as Sir Humphry Davy did not hesitate to affirm

that some of the doctrines of alchemy are not unphilosophical." This is an admission that the opinions of Newton, Leibnitz and Davy concerning alchemy were contrary to those now entertained by Dr. Bolton. On which side is the *weight?* Has Dr. Bolton ever distinguished himself by any scientific research? Has he made any notable discovery or invention? Has he propounded any law or doctrine of utility in the elucidation of natural truth? Or has he merely played the part of a scientific chronicler? If the answer to the last of these questions be in the affirmative, I think the scientific world will be slow to admit Dr. Bolton's authority to predicate 'cracked brains' in the cases of Newton, Leibnitz and Davy, or even in that of myself.

3. The bounden duty of a scientific chronicler is to be truthful and exact. Otherwise, his chronicles are misleading and injurious to the cause of science, and may seriously compromise the reputation of the journals that publish them. I regret very much to say that the article to which I am replying contains grave inaccuracies.

For example, after giving an account of Strindberg's famous gold-making experiment, Dr. Bolton says: "After showing by appropriate tests that iron is still present, the hermetic chemist proceeds to explain the reaction by assuming the formation of the hypothetical $Fe_2S=196=Au$ * * * and he adds, 'The chlorid of gold is reduced by the nicotine of the cigar.' Since, however, no reagent containing chlorin in any form was used in the experiment, this element must have been created at the same time with the gold, which, however, is 'incomplete' gold soluble in unmixed acids."

Now, I happen to possess a copy of Strindberg's 'Gold-Synthese,' and I am, therefore, able to quote his exact words, which are as follows:

"Man taucht ein Papierstreifchen in eine Lösung von Eisensulfat. Raucht über der Ammoniaksflasche, und es wird grün gefärbt (wie Goldoxidul); wärmt es über eine angezündeten Cigarre,* und es wird braun (wie Goldoxid). Später erscheinen gelbe metallische Flittern, welche aus Gold in äusserst verdumtem Zustande bestehen."

*Nikotin reducirt Gold.

Here it will be seen that not a word is said about chloride of gold or chlorine.

Perhaps Dr. Bolton has never seen Strindberg's 'Gold-Synthese,' and by reporting and quoting at second-hand has inadvertently borne false witness against his neighbor. An explanation is certainly in order.

Another instance of inaccuracy is the reference to Tiffereau. Dr. Bolton gives an account of a memoir submitted to the Académie des Sciences in which carbon-compounds were said to have been formed by the action of nitric acid on metallic aluminum; and he says, by way of comment: "Analytical chemists would criticise this experiment in several points; they would say Tiffereau did not demonstrate the absence of carbon in the metal used, and that he depended upon smell and taste for proofs of the carbon compounds."

The memoir here alluded to was merely a preliminary announcement. It was followed by another describing a much more complete test, in which the flask containing the nitric acid and aluminum was connected with one containing baryta-water, this latter showing a deposit of barium carbonate at the conclusion of the experiment. Tiffereau's exact words are as follows:

"Un chimiste expert, chargé de l'analyse, a trouvé dans le flacon *a*, du nitrate d'aluminum et un partie silicieuse dont le poids, aprés incineration, a été de 0.018.

"L'analyse du dépot du flacon *c* a décélé la presence du carbonate de baryum melangé avec de l'alumine dans les proportions suivantes—

| | |
|---|---|
| Carbonate de baryum . . | 0.129 |
| Alumine . . . . . | 0.005 |
| Poids du dépot . . . | 0.134 |

"L'expérience a donc donné 0.00785 de carbone, alors que l'aluminum employé n'en contenait que 0.00075, c'st à dire, 10 fois moins."

I ask all fair-minded men of science whether justice was done to Mons. Tiffereau in Dr. Bolton's paper, and whether the latter can be accepted as a scientifically-veracious account of a scientifically important research?

4. I now proceed to consider whether Dr. Bolton's attribution of 'cracked brains' to Newton, Leibnitz, Davy and myself, and his

wholesale denunciation of 'a company of educated charlatans' by whom he says 'the revival of alchemy is now being engineered' are indeed logical conclusions from admissible premisses.

His argument seems to be as follows:

A. Certain substances, each of which possesses certain specific physical properties, are by chemists denominated 'elements.'

No human being can, by any method, effect any change in any specific physical property of any 'element.'

Any human being who ventures to think that any method has been, or may yet be, discovered of changing any specific property of any element is, to that extent, insane.

Newton, Leibnitz, Davy and Emmens have been thus bold.

*Ergo*, they have 'cracked brains.'

B. Souls do not exist. There is no God. The universe consists solely of what physicists call Matter, Ether and Energy.

Any system of thought and research which enquires into Soul, as well as into Matter, Ether and Energy, is quackery.

Certain writings of certain members of a certain Society are based upon the recognition of Soul as an operative existence in connection with Matter, Ether and Energy.

*Ergo*, this Society is 'a company of educated charlatans.'

C. The honorary members of every Society must be adjudged to participate in the views expressed by all the writings of all the members of such Society.

Flammarion, Strindberg and Emmens have been elected as honorary members of the Alchemical Association of France.

*Ergo*, they are 'educated charlatans.'

If the foregoing tissue of self-evident nonsense be not a fair presentation of Dr. Bolton's argument, let him correct it. Should he attempt to do so, *while preserving a syllogistic form*, the result will be instructive to himself.

5. Finally, it is proper for me to state where I actually stand as regards the whole matter.

I do not claim, and have never claimed, to *make* gold in the alchemical sense of the phrase.

I do not ask, and have never asked, the scientific world for any recognition of my work in connection with the interchangeability of gold and silver. This Dr. Bolton has long known. At his request I sent him a copy of *Arcana Naturæ* in which is set forth a letter written by me on May 21, 1897, to Sir William Crookes, F.R.S. That letter contained the following words:

"The gold-producing work in our Argentaurum laboratory is a case of sheer Mammon-seeking. It is not being carried on for the sake of science or in a proselytizing spirit. *No disciples are desired and no believers are asked for.*"

I have, however, given every chemist and physicist the opportunity, if desired, of investigating the fundamental portion of my work. The necessary instructions for the requisite experiment have been widely published. I have thus shifted the *onus probandi*. Let the critics do a little solid scientific work as a foundation for their clamor before they snap at the heels of men who make discoveries while they ply idle pens.

I do not profess to have shown how gold or its simulacrum may be produced at a commercial profit. I should, indeed, have 'cracked brains' were I to part with the control of the greatest power the world has ever witnessed.

I do, however, profess to be utilizing this power for the good of science at large. In addition to various physical researches of great interest and importance now being prosecuted in the Argentaurum laboratory, I am aiding students of nature in all parts of the world to observe and collate *facts* in rectification of much hypothesis that now does duty for truth. By so doing I, of course, incur the enmity of those who bow the knee to Mumbo-Jumbo; but many a broad-minded and eminent leader of science is corresponding with me in terms of amity and sympathetic encouragement.

Stephen H. Emmens.

Addendum. I take this opportunity of making an explanation with reference to another matter.

It will be remembered that in SCIENCE of February 19, 1897, Professor R. S. Woodward noticed a book of mine entitled 'The Argentaurum Papers No. 1.' The notice was not a review and made no attempt to deal with any of the arguments in the book. It was merely a personal attack upon myself in terms calculated to seriously injure me in the exercise of my profession as a scientific expert. Self-defense was, therefore, necessary; and as I had what I judged to be good reason for supposing that the columns of SCIENCE were closed against any reply on my part, I laid the matter before my legal advisers, and, in accordance with their counsel, I commenced an action for libel against the 'responsible editor' of SCIENCE and Professor Woodward. I fully recognized the inexpediency of such actions as a general rule, and the desirability, in the true interests of philosophy, of permitting absolute freedom of criticism; but I supposed, in this particular case, that an appeal to the law was the only remedy within my reach. I have recently been led to understand that this supposition is erroneous, and that the right to be heard in self-defense was not disputed by the editor of SCIENCE. Under these circumstances I have no intention of proceeding further with the action for libel.

Since writing the foregoing I have received a letter from a very eminent Fellow of the Royal Society informing me that he has performed the crucial experiment suggested in my letter of May 21, 1897, to Sir William Crookes. The gold contained in a Mexican dollar after forty hours of intense cold and continued hammering was found to be 20.9 per cent. more than the quantity of gold contained in the same dollar before the test.

S. H. E.

## SCIENTIFIC LITERATURE.

*Encyclopédie scientifique des aide-mémoire, Les huiles minérales*, Petrole, Schiste, Lignite, par FRANCOIS MIRON. Licencié ès Sciences Physiques Ingénieur Civil. Publiée sous la direction de M. Léauté, Membre de L'Institut. Paris, Gautier-Villars et Fils.

There are no deposits of petroleum in France of commercial value. This fact may furnish a reason why no work upon petroleum of any value has been published in France.

When, a few years since, after a visit to Trinidad, I published a paper on the celebrated Lake, in the *American Journal of Science*, I sent a copy of the paper to M. Alphonse Daubrée and asked him to secure its translation and insertion in some reputable French scientific journal. It was reprinted entire in the *English Geological Magazine* and it was also translated and inserted in one of the scientific journals of Germany. M. Daubrée replied that, while he would like to comply with my request, the French journals printed only original articles. This statement may further explain why the papers of Dr. Hunt, published thirty years ago in French journals, are still quoted by French authors as if they were the only papers extant upon American petroleum. This fact may still further explain why the work before us, which forms a part of an 'Enclyclopédie des Aide-Mémoire,' is neither up to date nor correct to any date. Although the title page is without date, it appears to be just issued; yet the latest date mentioned in association with American petroleum is 1888 and with European petroleum is 1892.

Speaking of the distribution of petroleum, our author says, "In Ohio the deposits of Trumbull, Loraine and Washington were known from time immemorial." These counties are arranged inversely as to their importance, and the Trenton limestone deposits of northwest Ohio—by far the most important of all—are not mentioned at all. He says further, "In Colorado at Cañon City, in Michigan on the shores of Lake Huron, the county of Cumberland in Kentucky and the environs of Santa Clara county in California have yielded and still yield an important production." There is no production at all in Michigan, none of any importance in Cumberland county, Ky., and in California, while petroleum is found in Santa Clara county, the large and important production in that State, is yielded in Los Angeles and Ventura counties, several hundred miles south, between Santa Barbara and Los Angeles.

In his table which shows the geological distribution of petroleum the very important Trenton limestone deposits are not mentioned;

neither are the scarcely less important Tertiary deposits of California, the West Indies and South America. Again he says, "In certain deposits in America, above all, the pressure of the gas upon the oil is feeble; in Russia, on the contrary, it is very strong;" further, "It results that in America the greater part of the wells are exploited with pumps, whilst in Russia they spout of themselves." Proceeding, he illustrates the occurrence of petroleum in the crust of the earth with a diagram, which shows a subterranean chamber containing salt water, petroleum and gas in position, one below the other.

Now, these statements as to the gas pressure and pumping wells in the United States are absolutely false, and, while the theory that large cavities in the crust of the earth were filled with gas, oil and water, ranged according to their specific gravities, was broached by Professor E. B. Andrews more than thirty years since, it never found general acceptance, even at that early date, and has been wholly disproved years ago.

Concerning the origin of petroleum, he refers to Hunt's papers, printed nearly forty years ago, and has not a word to say concerning those of Lesley, Orton, Ashburner, Carll, Sadtler, etc.

We look in vain for any adequate statements concerning the nitrogen content of bitumen, particularly petroleum. But little more satisfaction can be found in the meagre notices of the work of Mabery and Smith upon the sulphur compounds of petroleum. And this is the more noticeable, inasmuch, as by referring to these papers at all, the author has shown himself not wholly unacquainted with the subject.

Perhaps one of the most remarkable examples of inadequacy, when due regard is had to the abundance of material from which to draw, is found in the figures and descriptions illustrating the methods and apparatus employed in drilling wells. As reference is made to Boverton Redwood—misspelled Bowerton—it might be inferred that M. Miron was acquainted with the classical work of that author. If he is, we do not understand why such puerile efforts were made, both in matter and quality of designs, to illustrate drilling tools.

But little more satisfaction can be gained from a perusal of the pages devoted to the processes employed in refining petroleum. While the descriptions are correct as far as they go, the illustrations are meagre and wholly unsatisfactory.

At page 127 we reach the consideration of schist oils, an industry which ought to be the pride of every Frenchman. The reader is informed that the origin of this industry dates from 1830, and was founded upon the efforts of the celebrated chemist Laurent, who discovered that, in distilling the schists called bituminous in closed vessels, a liquid was obtained susceptible of giving, after appropriate treatment, refined products like gasoline and the lamp oil of petroleum, as also heavy lubricating oils and paraffine. This statement, while partly true, is most astonishing, as the records of the French Patent Office show that long previous to the publication of Laurent's paper in 1833—not 1830—several French inventors had been at work on both these products and processes, and that while Laurent earned well-merited distinction in perfecting them the real merit of their invention belongs to several others, but especially to Sèlligue, who obtained his first patent in 1834, but who, according to his own statements, had been already many years at work on the development of his methods.

A lack of time and space prevents a further pursuit of details. To say that the book has no value would be saying too much; to say that the author had used a great opportunity to very little purpose would not be far from the truth. Why an author in any language should refer to Boverton Redwood's work on Petroleum, which is filled with reference to original articles in all languages, and leave out of consideration the papers of Lesley, Orton, Ashburner, Carll, Stevenson, Sadtler, etc., is difficult of explanation.

We would suggest that some French author who reads English should read the several hundred original papers extant on American petroleum, and give to French scientific literature a compendium of information on that interesting subject that would be, at the same time, full, reliable and up-to-date.

S. F. Peckham.

*A Short Handbook of Oil Analysis.* By AUGUSTUS H. GILL, S. B., PH.D., author of 'Gas and Fuel Analysis for Engineers;' Assistant Professor of Oil and Gas Analysis at the Massachusetts Institute of Technology, Boston, Mass. Philadelphia, J. B. Lippincott Company; London, 6 Henrietta Street, Covent Garden. 1898.

This little book is exactly what it professes to be—a short handbook. Yet, it is very seldom that one finds a book that contains more valuable material than is condensed within its one hundred and thirty-six pages. The book is not only very full and complete in itself, but its very extended references converts it into a catalogue of a small library of books and articles upon the subjects treated in its pages. This gives the book a value comparable only to the well known work of Allen, which appeared about ten years ago. In respect to convenient size for the laboratory table Dr. Gill's book is much to be preferred, while a very careful examination has failed to discover the omission of anything of importance, while absence of unnecessary details and the clear and systematic arrangement cannot be too highly commended. The book, too, belongs to that class that is not alone useful to the professional chemist, but is equally so to the practical technologist. It must not, however, be mistaken for a work on the technology of oils, which it is not.

The whole subject of 'Oil Analysis' has been covered so evenly and well that we found no occasion to call attention to particular pages. We commend the book as one that no chemist or technologist can do without.

S. F. PECKHAM.

*Zur Kenntniss der Kern und Zelltheilung bei den Sphacelariaceen.* Von WALTER T. SWINGLE. Berlin. 1897. Sep.-Abdruck, Pringh. Jahrbücher, B. XXX. H. 2-3, pp. 53, pl. 2.

Mr. Swingle is to be congratulated upon having made a considerable addition to the cytological knowledge of a group, which has received a great deal of attention from investigators. The important results were obtained, without exception, from the apical cell of *Stypocaulon scoparium*. The paper is quite complete historically and morphologically, but derives its chief interest from the additional light it throws upon much debated questions in cytology.

According to the author, kinoplasm and trophoplasm are not only sharply differentiated in the Sphacelariaceæ, but the trophoplasm manifests also a distinct separation into a peripheral coarsely reticulate portion, and a much more finely reticulate central portion. The marked structural demarcation of the two parts is heightened by the presence of numerous granules in the outer meshes of the coarser portion. The same peculiar granules are found in the finer reticulum, and here and there throughout the cytoplasm, though in reduced number. The significance of this peculiarity of the trophoplasm admits at present of no adequate explanation. One cannot, however, feel quite as certain as the author that it is not an artefact. As for the kinoplasm, it is remarkably distinct and persistent.

The achromatic spindle of *Stypocaulon* is more or less unique in its development. It consists of three sets of fibres, those of an incomplete central spindle, those of the mantle, and certain free fibres which have no equatorial connection. The author concluded that the spindle arises from the intrusion of the kinoplasmic fibres, since the radiations in the kinoplasm decrease concomitantly with the appearance of the achromatic spindle. This might easily happen, however, as Cheviakoff has suggested, by the solution and transfusion of the kinoplasmic substance. The actual intrusion of the fibres of the kinoplasm could only be proved by the observation of the punctation or perforation of the nuclear membrane itself.

The investigation of the nucleolus in *Stypocaulon* furnishes no definite support to any of the multitudinous hypotheses concerning its presence and function. The author rather inclines to the view that the nucleolus may be a special store of organic nutrition for the kinoplasmic elaboration of the achromatic spindle. The centrosomes are permanently present in the kinoplasm, and undergo division regularly. In this connection, it is interesting to note the recently enunciated opinion of Carnoy, to the effect that the nucleoli of the pronuclei of *Ascaris* become the centrosomes, and that there

is, in consequence, no division of the centrosomes.

The cell wall, arising after division, is apparently built upon the walls of those meshes of the reticulum that come to lie in what corresponds to the equatorial plane. From the author's statement, however, it is not improbable that a more or less rudimentary phragmoplast really exists.

*Das kleine botanische Practicum.* Von Eduard Strasburger. Jena, Gustav Fisher. 1897. Pp. 246, with 121 illustrations.

In the third edition of this excellent handbook, the subject-matter has been largely added to, chiefly on the subjects of microtomy, manipulation and Bacteriaceæ. The remainder of the text is essentially the same as in the second edition. It is quite superfluous to call attention to the originality and authoritativeness of the text, and to the excellence of the illustrations. The book has been long enough before botanists to be thoroughly and favorably known. It is inexplicable that, with such an adequate text accessible, each year should see the publication of text books which serve to overcrowd an already well-filled oblivion. In all cases it may not be possible, for lack of time, to offer so thorough an elementary course as that outlined in the Practicum. In such instances, it would be practicable to omit a certain amount of detail without detracting from the integrity or thoroughness of the work. At all events, the system is one that, from the kind of training it involves, should be generally in vogue.

Frederic E. Clements.

The University of Nebraska.

*Stones for Building and Decoration.* By George P. Merrill, Curator of Geology, U. S. Museum. Second Edition, revised and enlarged. New York, J. Wiley & Sons; London, Chapman & Hall. 1897. 8vo. Pp. ix + 506.

The first edition of this excellent work was based upon the handbook of the same author and his catalogue of the building stones in the United States National Museum at Washington. The treatise here presented consists of the original, with revised and rewritten matter, and well-illustrated text, brought down to date and in various ways improved. Many pages of new matter appear in the new edition and full-page plates have been interspersed in the text. Part I. consists of a discussion of the distribution, the composition and the character of the building stones of the United States, studied from the points of view of the physicist, of the chemist and of the geologist, as well as of the engineer and the architect. Part II. is devoted to 'Rocks, Quarries and Quarry-Regions,' and presents a detailed account and discussion of the several rocks employed in the arts, their composition, their varieties and their special characteristics. This section of the work is its principal portion, covering about 300 pages. Part III. describes the methods employed in quarrying, dressing and shaping stone, stone-cutting machinery, weathering, testing, protection and preservation. Part IV. consists of appendices of tabulated and other data relating to the valuable qualities of the stones, prices and costs, a list of important stone structures with dates of erection, and a bibliography and glossary. Eighteen figures in the text and nineteen full-page plates fully and handsomely illustrate the work.

The position and experience of the author of this treatise give ample guarantee of its accuracy, and an examination of the text will afford confirmation of this conclusion. It is well planned, well executed and exceptionally complete. The publishers have given it admirable form, a plain but neat and satisfactory binding, the press work and paper are good and the illustrations excellent, as a rule. The book has a good index. It will prove helpful to the architects and engineers of the country whenever important stonework is to be erected.

R. H. T.

## SOCIETIES AND ACADEMIES.

### ENTOMOLOGICAL SOCIETY OF WASHINGTON.

*January 6, 1898:* Fourteenth annual meeting. The address of the retiring President, Mr. C. L. Marlatt, was upon the subject of 'Old World Entomology.' The author recounted personal experiences and impressions gained during a four months' European tour, in the course of which matters entomological—and particularly as an applied science—were espe-

cially investigated. The aim was particularly to make the personal acquaintance of the men charged with official work in this field, and with the conditions under which work is done in Europe, as a basis for estimating the methods there employed for the new world. The address covered only the places visited and the individuals seen, and laid no claim, therefore, to being a complete review of the subject of applied entomology in Europe. The author discussed the status and condition of entomological museums, the official economic work, both in the central national bureaus and connected with agricultural, horticultural and forestry schools, and also the work carried on by private enterprise. Much attention was given to the forestry conditions, the methods of culture of fruit, etc., and also to the climatic and topographic features as bearing on the abundance of and control of injurious insects. The countries especially discussed were England, France, Switzerland, southern Germany, Austria-Hungary, Italy and Spain. The worst injurious insects of the countries named were particularly studied, and especially those that so far have not reached America, and which, it is extremely desirable, should be kept from gaining lodgment here. In this connection were mentioned particularly two important grape pests, the Cochylis *Tortrix ambiguella*, and the Pyrale *Tortrix pilleriana*; also the olive fruit fly of France, Italy and Spain, *Daucus oleæ*, and some insect enemies of forage crops and grasses. The present status of the gipsy moth in Europe was also particularly investigated.

In summarizing the results of the trip, the author laid stress on the exceptional weather conditions of the season covered (Aug.–Nov., 1897), which, on account of excessive rainfall and unusual cold, led to a great scarcity of insect life, and also to the absence of insect damage, which was almost complete. In fact, with the exception of the olive fruit fly, no serious damage by insects was noted in either forest growth or in the various fruit districts. It was pointed out that the deductions from a single season are, therefore, necessarily unfair and do not apply to normal conditions. The fact, however, that the climate of most of central and southern Europe is unfavorable, as a rule, to the abundant production of insects was strongly urged, and it was asserted that the immunity from insect damage in Europe generally as compared with America is almost solely attributed to this fact rather than to any exceptional efficacy or abundance of parasitic and predaceous insect enemies of the injurious species.

In the matter of the treatment of destructive insects it would appear also that we have little to learn or gain from the study of European methods, for the simple reason that the injury is so much less frequent and less serious that wholesale methods of control, such as are necessary here, are seldom or never employed. This applies especially to the scale insects. The grape must always be excepted, this being perhaps the only crop where the European and American grower meet on equal terms in the matter of insect enemies. The author gave as his belief that the greatest benefit to be derived from the study of applied entomology in Europe is in the ability to more correctly appreciate the facts of climate, forest growth and methods of culture of fruits, etc., pertaining there, without a personal acquaintance with which it is impossible, except in a general way, to determine the applicability of methods of work followed for conditions on this side of the Atlantic, which, while apparently often similar, are altogether different.

*February 10, 1898:* 132d regular meeting. Specimens were exhibited as follows:

By Mr. Ashmead, the male and female of *Hypota pectinicornis* from south Europe; remarkable from the flabellate antennæ of the male.

By Mr. Schwarz, cocoons of *Cactophagus validus*, taken from the trunk of the giant cactus, at Tucson, Ariz., by Mr. Hubbard. In these cocoons in the winter time occur dead and mutilated specimens of an undescribed species of Bothrideres, which are unable to escape and die within the cocoons.

By Mr. Pratt, a specimen of *Lachnosterna inversa*, collected at Keokuk, Iowa, by Dr. Shaffer, and bearing on its thorax two eggs of a dipterous parasite.

By Mr. Fairchild, a Javanese Phyllium closely resembling the guava leaf; also a photo-

graph of a mantid which mimics the coffee flower.

By Mr. Banks, a specimen *Tetragonophthalma dubia*, collected in the District of Columbia, and which is the first species of its family to be found in the local fauna.

By Mr. Schwarz, seeds of the sea grape of Florida, *Coccoloba uvifera*, with specimens of *Pseudomus inflatus* reared from the seeds by Mr. Hubbard.

Papers were read as follows:

By Dr. Smith, a discussion of recent papers on hemipterous mouth parts by Dr. Leon and Dr. Heymons. Dr. Smith showed that in his opinion the points brought out by these writers substantiate his position that the hemipterous beak is a maxillary structure, although both authors start with the assumption that it is labial.

The paper was briefly discussed by Messrs. Cook, Banks, Howard and Gill, all taking issue with Dr. Smith's conclusions.

By Mr. Banks, on Tarsonemus in America, describing *T. pallidus* n. sp., occurring on Chrysanthemum at Jamaica, N. Y., and collected by Mr. Sirrine.

By Mr. Cook, on a new family of Diplopoda from Alabama, describing *Desmonus earli* and the new family Desmonidæ.

L. O. Howard,
*Secretary.*

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 481st meeting of the Philosophical Society was held at the Cosmos Club at 8 p. m., March 5th. The first paper was by Mr. A. Lindenkohl, of the United States Coast and Geodetic Survey, on 'The Specific Gravity of the Waters of the Northeast Pacific Ocean.' The salient points of the address were as follows:

The discussion of temperatures and densities is mainly based on observations by the 'Challenger,' 'Vitiaz' and 'Albatross.' In the deeper parts of Bering Sea a minimum of temperature of 2°.8 is found in 146 metres depth, succeeded by a maximum of 3°.5 at 410 metres, thence a decrease to 1°.6 at the bottom. The density increases from the surface to the bottom, where it is as great, if not more so than in the open Pacific. The cold zone about the Kuriles is correctly ascribed by Makarof to the upheaval of cold water from lower strata. A feeble drift, the Davidson Eddy, is found along the northwest coast of America, and off the southern coast of California a warm and saline body of water is found in the summer to intervene between the coast and the cold California current. The 'Challenger' soundings indicate a constant sinking to a lower level of the waters of the South Pacific in their advance against the equatorial currents, attended by a rising of the colder waters of the latter towards the surface. The higher temperature and salinity in the greater depths near the Gulf of Panama is ascribed to the same cause. The greatest surface density thus far found is by the 'Vitiaz,' viz.: 1.0276 in Latitude 23° 50′ North and Longitude 163° 16′ East.

The second paper was by Professor Frank H. Bigelow, of the United States Weather Bureau, who gave a paper on the results of balloon ascensions in determining the temperatures of the air. An account of the several phases of the problem, produced by the different stages of condensation of the aqueous vapor in the atmosphere, and a distinction of the types of the vertical temperature gradient, introduced the subject. Then a recital of the most important voyages, and the statistics derived from them, was made, showing the data we have to work with. Next followed the details of the reduction and combination of the observations, and the method was explained of constructing a network diagram giving the gradients from the ground up to 16,000 metres and the heights of the isotherms throughout the year. The data was subdivided into High Areas, or Clear Weather, and Low Areas, or Cloudy Weather, and the courses of the gradients occurring in the morning and the evening hours, respectivley, were traced out. They diverge in the lower atmosphere, but converge in the neighborhood of 5,000 metres, whence a single line is traced to the upper limit, where the temperature has a nearly total constant fall from the ground in winter and summer. Emphasis was laid upon the fact that good mean results can be obtained from inferior data by the method of construction employed.

E. D. Preston,
*Secretary.*

BIOLOGICAL SOCIETY OF WASHINGTON—288TH MEETING, SATURDAY, FEBRUARY 26.

THE evening was devoted to a 'Symposium on the Teaching of Biology,' in which Messrs. E. L. Morris, W. H. Dall, Erwin F. Smith, Theo. N. Gill, H. J. Webber, B. W. Evermann, C. W. Stiles and E. L. Greene took part. The general consensus of opinion was that there should be more general zoology and botany taught than at present, and more work tending towards a knowledge of the principles of classification and the systematic arrangement of the various groups.

F. A. LUCAS,
*Secretary.*

TORREY BOTANICAL CLUB, FEBRUARY 8, 1898.

THE evening was devoted to the Asclepias, or Milkweed family.

The first paper was by Dr. H. H. Rusby, describing 'A New genus of Asclepiadaceæ from Bolivia.' Dr. Rusby discussed the tribal and generic characters of that family, and exhibited specimens of his new genus, which is a vine of vigorous growth and of pollinial position.

The second paper, by Miss Anna M. Vail, describe a new species of *Acerates*, or green-milkweed, with comparisons of the other species already known. Specimens and illustrations were exhibited, with remarks upon the history of the genus from its earliest species, *A. Floridana*, onward. As distinctive characters of *Acerates*, she mentioned its aspect, its form of hood and its lack of strong horn-like characters. The characteristics were further discussed by Dr. Edward L. Greene, who was present from Washington, and who emphasized the importance of its axillary subsessile umbels and the green color present in its flowers. The varieties of *Acerates viridiflora* were then discussed, especially with reference to their great difference in leaf-form. Miss Vail finds their flowers to be identical. Mr. Rydberg reported finding all four of these forms within one county of central Nebraska on the sandhills, but to the east the broader-leaf only and in western Nebraska a narrow-leaf variety only.

General discussion on the Asclepias family followed, participated in by Professor Greene, Dr. Britton, Dr. Rusby and others. Miss Vail, in answer to inquiries, indicated the difficulties in the way of regarding the horn in that genus as a midrib. It is very variable, often double, differs in character from the still-persistent midrib of the same hood, and in many Western species is replaced by a broad triangular lamina.

Miss Vail described her results when watching plants of *Asclepias Cornuti* last summer. Bees and many small insects directed themselves at at once to the glutinous top of the anther-column. They seemed to neglect the corona, and but little secretion was apparent in it, instead of the copious deposits of honey expected.

Professor Greene queried if the corona in this family might not prove to be the true corolla, and cited the Malvaceæ as similar in adhesion of the corolla to the stamen-tube. He said: "I would exclude from *Asclepias* every species which does not develop a terminal umbel. The only invariable character by which I would distinguish *Asclepias* and related genera is found in the anther-wing. The first index to a new genus is its aspect. It is the part of the systematic botanist to define, if possible, what the significant elements of this habit or aspect are. Habit is often strongly marked, even where clearly-accented characters are difficult to find. It is a nice genus which has both habit and clear characters."

Dr. Britton followed with description and exhibition of a new saltmarsh *Scirpus*, or bulrush, from Connecticut, related to *S. robustus* of Pursh, but with different inflorescence and achene. Dr. Britton also presented specimens of *Triosteum angustifolium* from Stratford, Ct., its previously-known stations northeast of Pennsylvania being only at New Brunswick, N. J., and Glen Cove, L. I. A large supply of roots from Stratford are now planted at the Botanic Garden to exhibit development.

EDWARD S. BURGESS,
*Secretary.*

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## SCIENTIFIC JOURNALS.

THE second number of the *American Journal of Physiology* opens with a demonstration by Professor W. T. Porter of the compression of the intramural vessels of the heart by the

squeeze of the contracting heart-muscle and an experimental analysis of the effect of this compression on the circulation through the walls of the heart. This is followed by an elaborate study of the influence of alcoholic drinks upon digestion by Professor Chittenden, Dr. Mendel and Mr. Jackson. The effect of distention of the ventricle on the flow of blood through the walls of the heart, the composition and nutritive value of edible fungi, the restoration of coordinated volitional movement after nerve 'crossing,' the digestive powers of papain, the gastric inversion of cane-sugar, and the structural changes in infusoria produced by lack of oxygen, are treated in investigations from the laboratories at Yale, Harvard, Columbia and Chicago. The contents of the first number are not less varied. The influence of borax on nutrition, the recovery of the heart from fibrillary contraction, the variations in daily activity produced by alcohol and by changes in barometric pressure and diet, the influence of high arterial pressure on the blood-flow through the brain, the elimination of strontium, the nutrition of the heart through the vessels of Thebesius and the coronary veins, the relation between the external stimulus applied to a nerve and the resulting nerve impulse as measured by the action current, the nature of the cardio-pneumatic movements, and the functions of the ear and the lateral line in fishes, is each the subject of a thorough experimental study by physiologists of the leading American universities. The excellence and the wide range of the seventeen contributions in the first two numbers of this journal, and the unanimous support that it receives from the physiologists of America, assure us that physiology now has in this country a special journal in the first rank. Much praise is due for the form in which these investigations are published. The quality of the paper, the design of the cover and the page, the press-work, and especially the beauty of the illustrations, are all most gratifying.

*American Chemical Journal*, March. 'On the Conversion of Methylpyromucic Acid into Aldehydopyromucic and Dehydromucic Acids:' By H. B. Hill and H. E. Sawyer. On the 3, 4, 5, 'Tribromaniline and some Derivatives of Unsymmetrical Tribrombenzol:' By C. Loring Jackson and F. B. Gallivan. 'A Convenient Gas Generator, and Device for Dissolving Solids:' By T. W. Richards. The author has devised a simple form of apparatus in which the material can come in contact with the fresh liquid, while the heavy solution produced by the reaction is withdrawn by means of a tube reaching to the bottom. He also gives a description of an apparatus to be used to increase the rate of solution of crystallized substances. 'A Redetermination of the Atomic Weight of Zinc:' By H. N. Morse and H. B. Arbuckle. By this work a correction has been made in the results obtained by Morse and Burton, as it has been shown that the oxide of zinc occludes both oxygen and nitrogen even at very high temperatures. This correction has raised the atomic weight to 65.46 from 65.33, the result obtained by Morse and Burton. 'Direct Nitration of the Paraffins:' By R. A. Worstall. 'On the Silver Salt of 4-Nitro 2-Aminobenzoic Acid and its Behavior with Alkyl and Acyl Halides:' By. H. L. Wheeler and B. Barnes. 'Formamide and its Sodium and Silver Salts:' By P. C. Freer and P. L. Sherman, Jr. 'A Study of the Reaction of the Diazophenols and of the Salts of Chlor- and Bromdiazobenzene with Ethyl and with Methyl Alcohol:' By F. K. Cameron. The author studied the influence of the hydroxyl group and of chlorine and bromine upon the decomposition of diazo compounds.

J. Elliott Gilpin.

A scientific paper, the *Forward*, has recently been established in Denmark and is said to have already a circulation of 100,000 copies, while maintaining an excellent standard of popular science. We have not seen a copy of this journal, but if the facts are as represented the two and a-quarter million people of Denmark are to be congratulated on their scientific interests.

Herr Gustav Fischer, Jena, has begun the publication of a *Centralblatt für die Grenzgebiete der Medizin und Chirurgie.*

M. Ballière, Paris, has begun the publication of an Atlas of Microbiologie, by M. E. Macé, the first part of which contains twenty colored plates.